

2017 HVAC

HVAC - Automatic - Bolt EV

SPECIFICATIONS

FASTENER SPECIFICATIONS

Reusable Threaded Fastener Tightening Specifications

Application	Specification
	Metric (English)
NOTE: <i>All fasteners listed in this table can be reused after removal.</i>	
Air Conditioning Wiring Harness Screw	2.5 N.m (22 lb in)
Air Inlet Valve Actuator Fastener	2.5 N.m (22 lb in)
Blower Motor Control Module Bolt	2.5 N.m (22 lb in)
Lever Screw	2.5 N.m (22 lb in)
Mode Valve Actuator Bolt	2.5 N.m (22 lb in)
Temperature Valve Actuator Fastener	2.5 N.m (22 lb in)

SCHEMATIC WIRING DIAGRAMS

HVAC WIRING SCHEMATICS

Power, Ground, Data Communication and Blower Controls

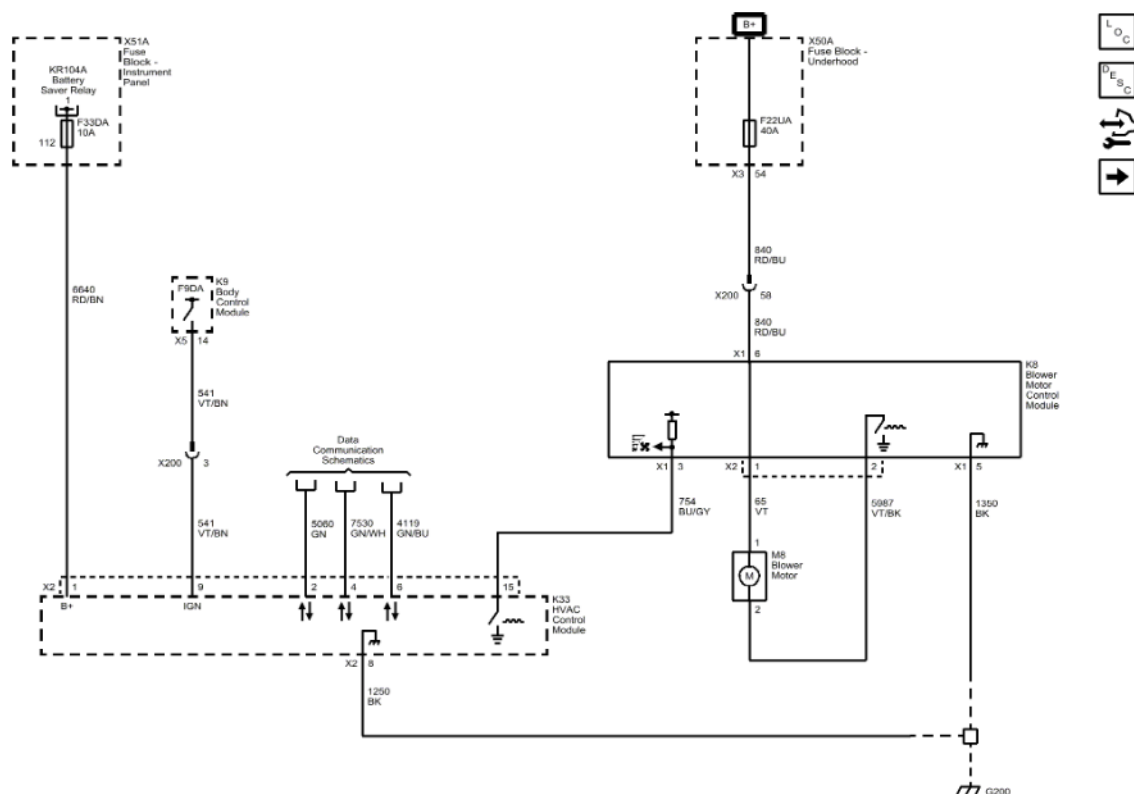


Fig. 1: Power, Ground, Data Communication and Blower Controls

Courtesy of GENERAL MOTORS COMPANY

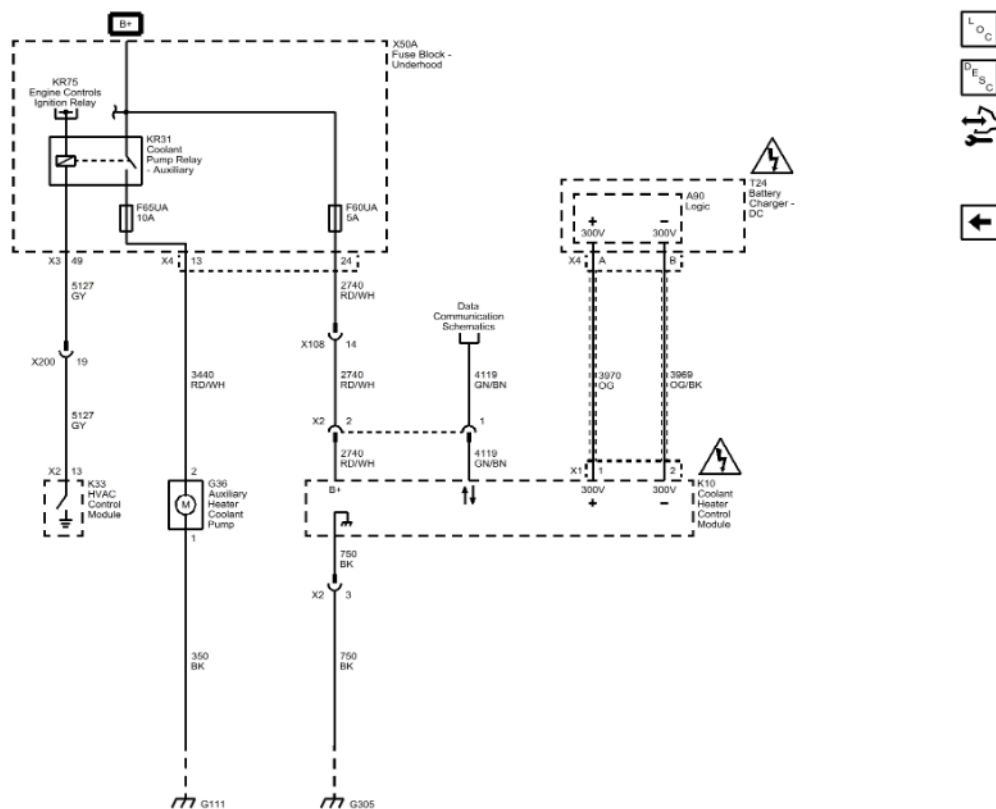


Fig. 4: Cabin Heater
Courtesy of GENERAL MOTORS COMPANY

Compressor Controls

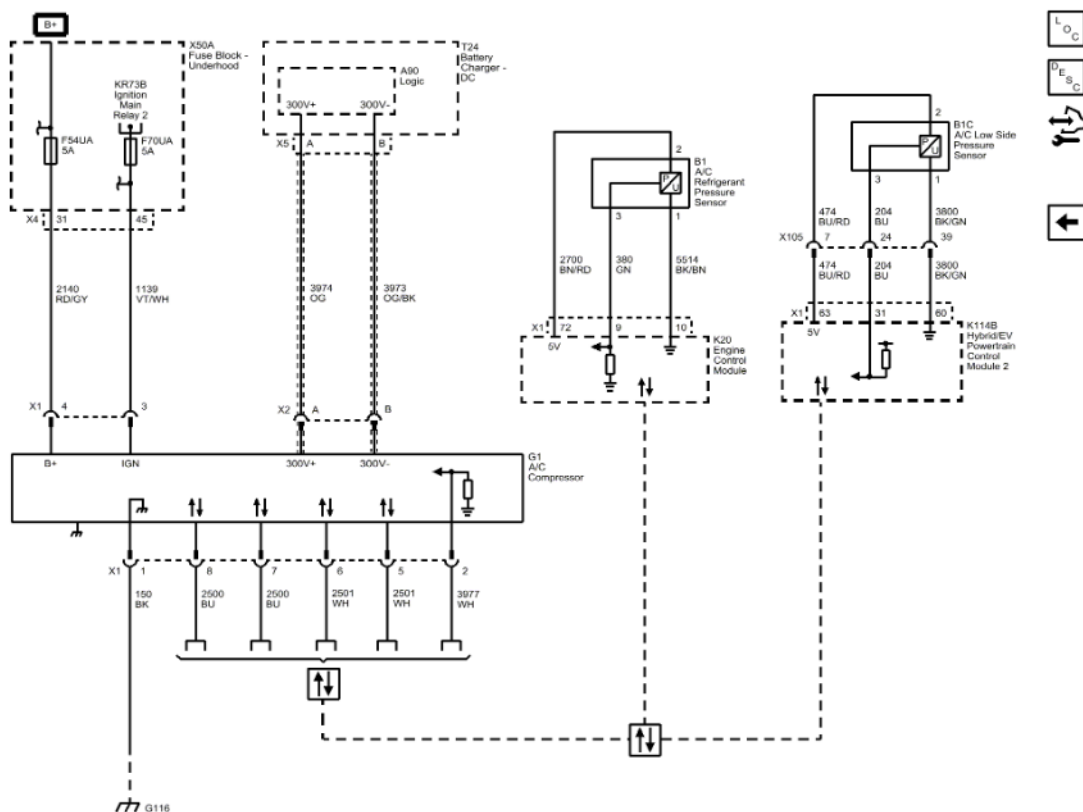


Fig. 5: Compressor Controls
Courtesy of GENERAL MOTORS COMPANY

HVAC COMPONENT REPLACEMENT REFERENCE

Component	Repair Instruction
A20 Radio/HVAC Controls	<u>Driver Information Display Replacement</u>
B1 A/C Refrigerant Pressure Sensor	<u>Air Conditioning Refrigerant Pressure Sensor Replacement - High Pressure</u>
B160 Windshield Temperature and Inside Moisture Sensor	<u>Inside Air Moisture and Windshield Temperature Sensor Replacement (With Front View Camera)</u> <u>Inside Air Moisture and Windshield Temperature Sensor Replacement (Without Front View Camera)</u>
B305 Ambient Light/Sunload Sensor and Battery State of Charge Indicator	<u>Sun Load, Ambient Light, and Charge Indicator Sensor Replacement</u>
B1C A/C Low Side Pressure Sensor	<u>Air Conditioning Refrigerant Pressure Sensor Replacement - Low Pressure</u>
B7B Air Temperature Sensor - Duct Lower	<u>Duct Air Temperature Sensor Replacement - Lower</u>
B7F Air Temperature Sensor - Duct Upper	<u>Duct Air Temperature Sensor Replacement - Upper</u>
G1 A/C Compressor	<u>Air Conditioning and Drive Motor Battery Cooling Compressor Replacement</u>
G17 Heater Coolant Pump	<u>Heater Coolant Pump Replacement</u>
K8 Blower Motor Control Module	<u>Blower Motor Control Replacement (Module Mounted)</u>
K10 Coolant Heater Control Module	<u>Heater Coolant Heater Replacement</u>
K33 HVAC Control Module	<u>Heater and Air Conditioning Remote Control Replacement</u>
M6 Air Temperature Actuator	<u>Temperature Valve Actuator Replacement</u>
M8 Blower Motor	<u>Blower Motor Replacement</u>
M37 Mode Door Actuator	<u>Mode Valve Actuator Replacement</u>
M46 Air Recirculation Door Actuator	<u>Air Inlet Valve Actuator Replacement</u>

DTC B0173 OR B0178: UPPER/LOWER LEFT DUCT AIR TEMPERATURE SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0173 02

Upper Left Duct Air Temperature Sensor Circuit Short to Ground

DTC B0173 05

Upper Left Duct Air Temperature Sensor Circuit High Voltage/Open

DTC B0178 02

DTC B0178 05

Lower Left Duct Air Temperature Sensor Circuit High Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Upper Left Duct Air Temperature Sensor Signal	B0173 02	B0173 05	B0173 05	-
Lower Left Duct Air Temperature Sensor Signal	B0178 02	B0178 05	B0178 05	-
Low Reference	-	B0173 05, B0178 05	-	-

Circuit/System Description

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The vehicle uses the following air temperature sensors:

- Air temperature sensor left upper
- Air temperature sensor left lower

A signal and low reference circuit enables the sensor to operate. As the air temperature surrounding the sensor increases, the sensor resistance decreases. The sensor signal voltage decreases as the resistance decreases. The sensor operates within a temperature range between -40 to +85°C (-40 to +185°F). The sensor signal varies between 0 - 5 V. The HVAC control module converts the signal to a range between 0 - 255 counts. As the air temperature increases the count value will decrease. If the HVAC control module detects a malfunctioning sensor, then the control module software will use a default air temperature value. The default action ensures that the HVAC system can adjust the inside air temperature near the desired temperature until the condition is corrected.

Conditions for Running the DTC

The vehicle is turned ON.

Conditions for Setting the DTC

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V or greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

A default value is used when the DTC is set.

Conditions for Clearing the DTC

- The DTC will become history if the HVAC control module no longer detects a failure.
- The history DTC will clear after 100 fault-free ignition cycles.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the appropriate temperature sensor. It may take up to 10 minutes for all vehicle systems to power down.
2. Test for less than 10 Ω between the appropriate low reference circuit terminal listed below and ground.
 - B7B Air Temperature Sensor - Duct Lower - terminal 3
 - B7F Air Temperature Sensor - Duct Upper - terminal 1
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the appropriate signal circuit terminal listed below and ground.
 - B7B Air Temperature Sensor - Duct Lower - terminal 1
 - B7F Air Temperature Sensor - Duct Upper - terminal 3
 - **If less than 4.8 V**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.
 - **If greater than 5.2 V**
 1. Ignition OFF, disconnect the harness connector at the K33 HVAC Control Module, ignition ON.
 2. Test for less than 1 V between the signal circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC Control Module.
 - **If between 4.8 - 5.2 V**
5. Test or replace the temperature sensor.
6. Verify the DTC or symptom is corrected while operating the HVAC system under the Conditions for Running the DTC.
 - **If the DTC or symptom is not corrected**

Replace the K33 HVAC Control Module.
 - **If the DTC or symptom is corrected**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC B018A, B048C, B048F, OR B1395: WINDSHIELD TEMPERATURE SENSOR/HUMIDITY SENSOR CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B018A 02

Windshield Temperature Sensor Circuit Short to Ground

DTC B018A 05

Windshield Temperature Sensor Circuit High Voltage/Open

DTC B048C 02

Humidity Sensor Humidity Circuit Short to Ground

DTC B048C 05

Humidity Sensor Humidity Circuit High Voltage/Open

DTC B048F 02

Humidity Sensor Temperature Circuit Short to Ground

DTC B048F 05

Humidity Sensor Temperature Circuit High Voltage/Open

DTC B1395 03

Control Module Voltage Reference Output Circuit Low Voltage

DTC B1395 07

Control Module Voltage Reference Output Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	B1395 03	-	B1395 07	-
Signal Terminal 2	B048C 02	B048C 05	B048C 05	-
Signal Terminal 5	B048F 02	B048F 05	B048F 05	-
Signal Terminal 4	B018A 02	B018A 05	B018A 05	-
Ground	-	B018A 05, B048C 05, B048F 05	-	-

Circuit/System Description

The windshield temperature and inside moisture sensor integrates the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level on inside windshield
- Temperature of the inside windshield
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity on the compartment side of the windshield. It also detects the temperature of the windshield surface on the compartment side. Both values are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element. It is only needed if the thermal contact between the humidity sensing element and the inside windshield surface is not sufficient.

Conditions for Running the DTC

- Vehicle ON or Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B018A 02, B048C 02, B048C 02 or B1395 03

The HVAC control module detects the sensor signal out of range. The signal voltage is less than 0.1 V for more than 50 ms.

B018A 05, B048C 05, B048C 05 or B1395 07

The HVAC control module detects the sensor signal out of range. The signal voltage is greater than 4.9 V for more than 50 ms.

Action Taken When the DTC Sets

- The system will use the last valid values as default.
- If no value is read at the time of fault, the HVAC control module uses 60% for humidity.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

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Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**

- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B160 windshield temperature and inside moisture sensor. It may take up to 2 minutes for all vehicle systems to power down.
2. Test for less than 60 Ω between the low reference circuit terminal 3 and ground.
 - **If 60 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If less than 60 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 1 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, Vehicle in Service Mode.
 2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC control module.
 - **If between 4.8 - 5.2 V**
5. Verify the scan tool parameters listed below are less than -37 $^{\circ}$ C (-35 $^{\circ}$ F).
 - Windshield Temperature
 - Passenger Compartment Humidity Sensor Temperature
 - **If -37 $^{\circ}$ C (-35 $^{\circ}$ F) or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the signal circuit terminals listed below and ground:
 - Windshield temperature sensor signal terminal 4
 - Passenger compartment humidity sensor temperature signal terminal 5
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
 - **If less than -37 $^{\circ}$ C (-35 $^{\circ}$ F)**
6. Verify the scan tool Passenger Compartment Humidity parameter is greater than 95%.
 - **If 95% or less**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.

2. Test for infinite resistance between the signal circuit terminal 2 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC control module.
- **If greater than 95%**
7. Install a 3 A fused jumper wire between each signal circuit terminal listed below and the low reference circuit terminal 3 one at a time.
 - Windshield temperature sensor signal terminal 4
 - Passenger compartment humidity sensor temperature signal terminal 5
8. Verify the appropriate scan tool parameter listed below is greater than 114Â°C (238Â°F).
 - Windshield Temperature
 - Passenger Compartment Humidity Sensor Temperature
 - **If 114Â°C (238Â°F) or less**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for less than 1 V between the signal circuit terminals listed below and ground:
 - Windshield temperature sensor signal terminal 4
 - Passenger compartment humidity sensor temperature signal terminal 5
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K33 HVAC control module.
 - **If greater than 114Â°C (238Â°F)**
9. Install a 3 A fused jumper wire between the passenger compartment humidity sensor signal circuit terminal 2 and the low reference circuit terminal 3.
10. Verify the scan tool Passenger Compartment Humidity parameter is less than 5%.
 - **If 5% or greater**
 1. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module.
 2. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω, replace the K33 HVAC control module.
 - **If less than 5%**
11. Vehicle OFF, disconnect the harness connector at the K33 HVAC control module, Vehicle in Service Mode.
12. Test for less than 1 V between the signal circuit terminal 2 and ground.
 - **If 1 V or greater**

Repair the short to voltage on the circuit.

 - **If less than 1 V**
13. Test or replace the B160 windshield temperature and inside moisture sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for HVAC control module replacement, programming and setup

DTC B0193: FRONT BLOWER MOTOR SPEED CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.

- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0193 01

Front Blower Motor Speed Circuit Short to Battery

DTC B0193 06

Front Blower Motor Speed Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Blower Motor Control Module B+	B0193 06	B0193 06	-	-
Blower Motor B+	1	1	-	-
Blower Motor Control Module Control	B0193 06	B0193 06	B0193 01	-
Blower Motor Control	2	1	1	-
Blower Motor Control Module Ground	-	1	-	-
1. Blower Motor Inoperative 2. Blower Motor Always ON				

Circuit/System Description

The blower motor control module is an interface between the HVAC control module and the blower motor. The blower motor control module has 5 circuits: a B+ input, ground, a control circuit from the HVAC control module, a B+ output to the blower motor, and a low side pulse width modulation (PWM) output. The HVAC control module provides a low side (PWM) signal to the blower motor control module in order to request the blower motor speed. The blower motor control module grounds the blower motor using a low side PWM signal in order to vary the blower motor speed.

Conditions for Running the DTC

- Vehicle in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B0193 01

The voltage at the HVAC control module output to the blower motor control module is always high.

B0193 06

The voltage at the HVAC control module output to the blower motor control module is always low or fluctuating.

Action Taken When the DTC Sets

The blower motor is inoperative.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

Inspect the motor shaft for rust or other foreign material which may prohibit proper motor operation.

If the motor operates properly please reinstall it and check for Preliminary Information or Technical Service Bulletins.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

Scan Tool Reference

[Control Module References](#) for scan tool information

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the X1 harness connector at the K8 Blower Motor Control Module. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the ground circuit terminal 5 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
3. Verify a test lamp illuminates between the B+ circuit terminal 6 and ground.
 - **If the test lamp does not illuminate and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp.
 2. Test for less than 2 Ω in the B+ circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , verify the fuse is not open and there is voltage at the fuse.
 - **If the test lamp does not illuminate and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the B+ circuit terminal 6 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Disconnect the X2 harness connector at the K8 Blower Motor Control Module and disconnect the harness connector at the M8 Blower Motor.
 4. Test for infinite resistance between the M8 Blower Motor B+ circuit terminal 1 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the M8 Blower Motor.
- **If the test lamp illuminates**

4. Vehicle in Service Mode. Test for less than 1 V between the control circuit terminal 3 and ground.

- **If 1 V or greater**

1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC Control Module. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K33 HVAC Control Module

- **If less than 1 V**

5. Vehicle OFF. It may take up to 10 min for all vehicle systems to power down.

6. Test for infinite resistance between the control circuit terminal 3 and ground.

- **If less than infinite resistance**

1. Disconnect the X2 harness connector at the K33 HVAC Control Module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module

- **If infinite resistance**

NOTE: Verify the ignition is OFF before connecting the blower motor control module or incorrect test results may occur.

7. Vehicle OFF, connect the X1 harness connector at the K8 Blower Motor Control Module. Vehicle in Service Mode.

8. While backprobing terminal 3 at the K8 Blower Motor Control Module, test for greater than 1 V between the control circuit and ground.

- **If less than 1 V**

Replace the K8 Blower Motor Control Module.

- **If 1 V or greater**

9. Verify the voltage decreases and increases while using the controls to change the blower speed selection.

- **If the voltage does not decrease and increase as the blower speed selection is changed**

1. Vehicle OFF, disconnect the X2 harness connector at the K33 HVAC Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.

- **If the voltage decreases and increases as the blower speed selection is changed**

10. Vehicle OFF, disconnect the harness connector at the M8 Blower Motor, Vehicle in Service Mode and blower ON.

11. Verify a test lamp illuminates between the B+ circuit terminal 1 and ground.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K8 Blower Motor Control Module.

- **If the test lamp illuminates**

12. Connect a test lamp between control circuit terminal 2 and B+ circuit terminal 1.

13. Verify the test lamp becomes progressively brighter as the blower speed is increased and progressively dimmer as the blower speed is decreased.

- **If the test lamp does not illuminate**

1. Vehicle OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module, Vehicle in Service Mode.

2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω replace the K8 Blower Motor Control Module.
- **If the test lamp illuminates, but does not change in brightness**
 1. Vehicle OFF, disconnect the X2 harness connector at the K8 Blower Motor Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K8 Blower Motor Control Module.
- **If the test lamp changes in brightness as the blower speed is changed**
14. Test or replace the M8 Blower Motor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC B0223, B0233, B023A, OR B0408: AIR FLOW/TEMPERATURE CONTROL

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B0223

Recirculate Position Command 1 Circuit

DTC B0233

Air Flow Control Circuit

DTC B023A

HVAC Actuators Supply Voltage

DTC B0408

Main Temperature Control Circuit

For symptom byte information refer to [Symptom Byte List](#).

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Stepper Motors 12 V Reference	B023A 02	B0223 06, B0233 06, B0408 06, 1	-	-
Recirculation Actuator Control 1	B0223 06, 1	B0223 06, 1	B0223 01, 1	-

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Recirculation Actuator Control 2	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 3	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Recirculation Actuator Control 4	B0223 06, 1	B0223 06, 1	B0223 01, 1	-
Air Temperature Actuator Control 1	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 2	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 3	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Air Temperature Actuator Control 4	B0408 06, 1	B0408 06, 1	B0408 01, 1	-
Mode Actuator Control 1	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 2	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 3	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
Mode Actuator Control 4	B0233 06, 1	B0233 06, 1	B0233 01, 1	-
1. Actuator door malfunction				

Circuit/System Description

Stepper motors are used for temperature regulation, air distribution control and recirculation flap control.

With the appropriate switches at the HVAC control, the desired door positions can be selected. The selected values are passed to the HVAC control module via serial data. The HVAC control module supplies a 12 V reference voltage to the stepper motors and energizes the stepper motors with a pulsed ground signal. The stepper motors put the appropriate door into the calculated position in order to reach the desired temperature, mode, and recirculation position.

Conditions for Running the DTC

- Vehicle on, or in Service Mode.
- The HVAC control module is ON.

Conditions for Setting the DTC

B023A 02

The stepper motors supply output is shorted to ground.

B0223 01, B0233 01 or B0408 01

At least one control output (of 4 possible outputs) of the appropriate stepper motor is shorted to voltage when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

B0223 06, B0233 06 or B0408 06

At least one control output (of 4 possible outputs) of the appropriate stepper motor is shorted to ground or open when motor starts moving. Faults are not detected when motor is already running or target position is already reached.

Action Taken When the DTC Sets

B023A 02

- The affected output will be switched off for hardware protection.

- All stepper motors are deactivated.

B0223, B0233 or B0408

- The affected output will be switched off for hardware protection.
- The affected stepper motor is deactivated.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

During diagnosis, it is important to verify that the air control door and any associated components (linkage, cams, gears, etc.) operate properly. Inspect for any conditions that may limit or prevent the air control door from moving smoothly or moving through its full range of travel. Any mechanical issues should be corrected first, before proceeding with electrical diagnosis.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Perform the **Actuator Recalibration** procedure.
2. Verify the concern or DTC has been corrected.
 - **If the concern or DTC has not been corrected**
 1. Verify DTC B023A is not set.
 - If DTC B023A is set, refer to Circuit/System Testing - DTC B023A
 - If DTC B023A is not set, refer to Circuit/System Testing - DTC B0223, B0233 or B0408.
 - **If the concern or DTC has been corrected**
3. All OK.

Circuit/System Testing

DTC B023A

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the components listed below. It may take up to 2 min for all vehicle systems to power down.
 - M37 Mode Door Actuator

- M46 Air Recirculation Door Actuator
 - M6 Air Temperature Door Actuator
2. Disconnect the X3 harness connector at the K33 HVAC Control Module.
 3. Test for infinite resistance between the K33 HVAC Control Module circuit terminal 15 X3 and ground.
 - **If less than infinite resistance**
Repair the short to ground on the circuit.
 - **If infinite resistance**
 4. Vehicle OFF, connect the X3 harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
 5. Verify DTC B023A is not set.
 - **If the DTC is set.**
Replace the K33 HVAC Control Module.
 - **If the DTC is not set.**
 6. Verify DTC B023A does not set after connecting each of the components listed below one at a time and operating them through their full range.
 - M37 Mode Door Actuator
 - M46 Air Recirculation Door Actuator
 - M6 Air Temperature Door Actuator
 - **If the DTC sets after connecting one of the components**
Replace the actuator that was connected immediately before the DTC set.
 - **If the DTC does not set**
 7. All OK.

DTC B0223, B0233 or B0408

1. Vehicle OFF, disconnect the harness connector at the appropriate door actuator, It may take up to 2 min for all vehicle systems to power down. Vehicle in Service Mode.

NOTE: **If more than one actuator is affected, test the B+ circuit at each actuator.**

2. Verify a test lamp illuminates between the B+ circuit terminal 2 and ground.
 - **If the test lamp does not illuminate**
 1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC control module.
 - **If the test lamp illuminates**
3. Command the appropriate actuator with a scan tool.
4. Verify a test lamp is flashing on and off when connected between the B+ circuit terminal 2 and each control circuit terminal listed below:
 - Control Circuit - terminal 1
 - Control Circuit - terminal 3
 - Control Circuit - terminal 4
 - Control Circuit - terminal 6

- **If the test lamp is always OFF**

1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module. Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.

- **If the test lamp is always ON**

1. Vehicle OFF, disconnect the X3 harness connector at the K33 HVAC control module.
2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.

- **If the test lamp is flashing On and Off**

5. Test or replace the actuator.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC B048E: AUXILIARY HEATER SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC B048E 00

Auxiliary Heater System Malfunction

DTC B048E 39

Auxiliary Heater System Internal Malfunction

DTC B048E 58

Auxiliary Heater System Incorrect Reaction After Event

DTC B048E 5A

Auxiliary Heater System Plausibility Failure

Circuit/System Description

The coolant heater control module is a high voltage electric heater. High voltage is supplied from the hybrid/EV battery pack. A fused battery input, ground, and LIN serial data from the HVAC control module are used to control the operation of the coolant heater control module.

The HVAC control module requests heater operation if the coolant temperature is low and additional heat is required to meet the desired settings of the HVAC system.

The coolant heater control module monitors itself during operation, and if a fault is detected a message is sent to the HVAC control module. The HVAC control module then sets the DTC.

Conditions for Running the DTC

- 12 V battery system voltage is greater than 10.2 V.
- The HVAC control module is ON.
- The electrical auxiliary heater is commanded ON.

Conditions for Setting the DTC

B048E 00

- The coolant heater control module reports a recoverable fault for greater than 30 seconds.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 39

- The coolant heater control module reports an internal malfunction for greater than 30 seconds.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 58

- The coolant heater control module reports a limited operation status for greater than 10 minutes.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

B048E 5A

- The HVAC control module determines the coolant temperature reported by the coolant heater control module is not rational based on the vehicle operating conditions for greater than 10 minutes.
- The condition is present for 3 consecutive ignition cycles
- The HVAC control module sets the DTC on the fourth ignition cycle

Action Taken When the DTC Sets

- The DIC displays the Service Heater Soon message
- The coolant heater is inoperative, or operates in a limited state.

Conditions for Clearing the DTC

The condition for setting the DTC is no longer present.

Diagnostic Aids

- Verify the cooling system is full before performing diagnostics. A low or aerated coolant condition may cause this DTC to set.
- Insufficient or no coolant flow through the coolant heater due to a restriction, blockage, or coolant pump malfunction may cause this DTC to set.
- Insufficient or no voltage from the Hybrid/EV battery may cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

NOTE: Check for bulletins before proceeding.

1. Verify that no other DTCs are set.

- **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

2. Verify that DTC B048E 39 is not set.

- **If DTC B048E 39 is set**

Replace the K10 Coolant Heater Control Module

- **If DTC B048E 39 is not set**

3. Verify that DTC B048E 00 is not set.

- **If DTC B048E 00 is set**

Refer to Circuit/System Testing

- **If DTC B048E 00 is not set**

4. Verify the cooling system is filled to the proper level.

- **If the cooling system is not filled to the proper level**

1. Diagnose and correct the cause of the improper coolant level.

2. Fill the cooling system to the proper level. Refer to .

3. Clear DTCs and re-evaluate the concern.

- **If the cooling system is filled to the proper level**

5. Verify the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter.

- **If the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is NOT within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter**

Allow the system to cool until the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter.

- **If the Coolant Heater Control Module Inlet Coolant Temperature sensor parameter is within 5Â°C (9Â°F) of the Ambient Air Temperature sensor parameter**

6. Verify the G36 Auxiliary Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.

- **If the G36 Auxiliary Heater Coolant Pump does not operate**

Refer to [Auxiliary Heater Coolant Pump Malfunction](#).

- **If the G36 Auxiliary Heater Coolant Pump operates**

7. Vehicle ON, HVAC system set to hot, blower set to high.

8. Verify the scan tool parameter Coolant Heater Control Module Status displays only Normal Running.

- **If the scan tool parameter Coolant Heater Control Module Status displays only Limited Operation**

1. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60°C (140°F) and the parameter Coolant Heater Current is greater than 15 A.

- If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60°C (140°F) and the parameter Coolant Heater Current is less than 15 A, replace the K10 Coolant Heater Control Module
- If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is less than 60°C (140°F) and the parameter Coolant Heater Current is greater than 15 A, refer to step 9.

- **If the scan tool parameter Coolant Heater Control Module Status switches between Limited Operation and Normal Running.**

Refer to step 10.

- **If the scan tool parameter Coolant Heater Control Module Status displays only Normal Running**

9. Continue to operate the system for 10 min.

10. Verify the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is within 5°C (9°F) of parameter Desired Heater Core Outlet Coolant temperature.

- **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is not within 5°C (9°F) of parameter Desired Heater Core Outlet Coolant temperature.**

Replace the K10 Coolant Heater Control Module

- **If the scan tool parameter Coolant Heater Control Module Inlet Coolant Temperature is within 5°C (9°F) of parameter Desired Heater Core Outlet Coolant temperature.**

11. Vehicle OFF. Inspect the cooling system for restrictions or blockages in coolant flow. Refer to [Heating Performance Diagnostic](#).

- **If restrictions or blockages in coolant flow are found.**

1. Diagnose and correct the cause of the restrictions or blockage.
2. Verify the G36 Auxiliary Heater Coolant Pump operates.
3. Clear DTCs and re-evaluate the concern.

- **If no restrictions or blockages are found**

12. All OK.

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must

be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the K10 Coolant Heater Control Module. Refer to [High Voltage Disabling](#) .
2. Disconnect the X2 harness connector at the K10 Coolant Heater Control Module and the X4 harness connector at the T24 Battery Charger - DC. Refer to [High Voltage Connectors](#) .
3. Test for less than 2 Ω end to end between the 300-Volt Positive and Negative Cable circuit terminals listed below:

- K10 Coolant Heater Control Module harness connector terminal A X2 and T24 Battery Charger - DC harness connector terminal A X4.
- K10 Coolant Heater Control Module harness connector terminal B X2 and T24 Battery Charger - DC harness connector terminal B X4.
- **If 2 Ω or greater**

Replace the 300-Volt Positive and Negative Cable.

- **If less than 2 Ω**

4. Disconnect the X3 harness connector at the T24 Battery Charger - DC. Refer to [High Voltage Connectors](#) .

5. Test for less than 2 Ω between the component terminals listed below:

- T24 Battery Charger - DC connector terminal A X3 and T24 Battery Charger - DC connector terminal A X4.
- T24 Battery Charger - DC connector terminal B X3 and T24 Battery Charger - DC connector terminal B X4.
- **If 2 Ω or greater**

Replace the T24 Battery Charger - DC and the K10 Coolant Heater Control Module.

- **If less than 2 Ω**

6. Replace the K10 Coolant Heater Control Module.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC B3844: ENGINE COOLANT CIRCULATION PUMP CIRCUIT

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B3844 01

Engine Coolant Circulation Pump Circuit Short to Battery

DTC B3844 06

Engine Coolant Circulation Pump Circuit Low Voltage/Open

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B3844 06, 2	B3844 06, 1	B3844 01, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires the coolant heater to operate, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay. The coolant pump then circulates the coolant within the coolant heater system.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- Circuit Testing
- Connector Repairs
- Testing for Intermittent Conditions and Poor Connections
- Wiring Repairs

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G17 Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
 - **If the G17 Heater Coolant Pump does not operate**
Refer to Circuit/System Testing
 - **If the G17 Heater Coolant Pump operates**
3. All OK.

Circuit/System Testing

1. Vehicle OFF, disconnect the X3 harness connector at the X50A Fuse Block- Underhood.
2. Connect a test lamp between the control circuit terminal 49 and B+, Vehicle in Service Mode.
3. Verify the test lamp turns ON and OFF when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
 - **If the test lamp is always OFF**

1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K33 HVAC Control Module, Vehicle in Service Mode.
2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V
3. Vehicle OFF.
4. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K33 HVAC Control Module.
- **If the test lamp is always ON**
 1. Vehicle OFF, remove the test lamp, disconnect the X2 harness connector at the K33 HVAC Control Module.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, replace the K33 HVAC Control Module.
- **If the test lamp turns ON and OFF**
4. Vehicle OFF and all vehicle systems OFF, connect the X3 harness connector at the X50A Fuse Block- Underhood. Disconnect the harness connector at the G17 Heater Coolant Pump. It may take up to 2 min for all vehicle systems to power down.
5. Test for less than 10 Ω between the ground circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF.
 2. Test for less than 2 Ω in the ground circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , repair the open/high resistance in the ground connection.
 - **If less than 10 Ω**
6. Connect a test lamp between the control circuit terminal 2 and ground.
7. Verify the test lamp turns ON and OFF when commanding the Auxiliary Coolant Pump ON and OFF with a scan tool.
 - **If the test lamp is always OFF and the circuit fuse is good**
 1. Vehicle OFF, remove the test lamp, disconnect the X4 harness connector at the X50A Fuse Block- Underhood.
 2. Test for less than 2 Ω in the control circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the X50A Fuse Block- Underhood.
 - **If the test lamp is always OFF and the circuit fuse is open**
 1. Vehicle OFF, remove the test lamp.
 2. Test for infinite resistance between the control circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance, test or replace the G17 Heater Coolant Pump.
 - **If the test lamp is always ON**
 1. Vehicle OFF, disconnect the disconnect the X4 harness connector at the X50A Fuse Block- Underhood, Vehicle in Service Mode.
 2. Test for less than 1 V between the control circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the X50A Fuse Block- Underhood.
 - **If the test lamp turns ON and OFF**
8. Test or replace the G17 Heater Coolant Pump.

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P0532 OR P0533: AIR CONDITIONING (A/C) REFRIGERANT PRESSURE SENSOR CIRCUIT LOW/HIGH VOLTAGE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of the diagnostic category.

DTC Descriptors

DTC P0532

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit Low Voltage

DTC P0533

Air Conditioning (A/C) Refrigerant Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0532	P0532	P0533	-
Signal	P0532	P0532	P0533	-
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module monitors the high side refrigerant pressure through the high side A/C refrigerant pressure sensor. The engine control module supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the engine control module to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the engine control module commands the cooling fans on.

Conditions for Running the DTC

P0532 and P0533

- Any of the conditions for setting the DTC are met for 15 s.
- 12 V battery system voltage is between 11 - 18 V.

Conditions for Setting the DTC

P0532

The engine control module detects that the A/C pressure is less than 2.5 V.

P0533

The engine control module detects that the A/C pressure is greater than 4.75 V.

Action Taken When the DTC Sets

This is a type B DTC.

Conditions for Clearing the DTC

This is a type B DTC.

Diagnostic Aids

A malfunction within the refrigerant system causing high pressure can cause this DTC to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Install the appropriate Air Conditioning Service Center.
3. Verify the high side pressure reading on the Air Conditioning Service Center gauge is within 10% of the scan tool ECM A/C High Side Pressure Sensor parameter.
 - **If the reading is not within 10%**

Refer to Circuit/System Testing.
 - **If the reading is within 10%**
4. Refer to **Air Conditioning (A/C) System Performance Test** .

Circuit/System Testing

1. Vehicle OFF and all vehicle systems OFF, disconnect the harness connector at the B1 A/C Refrigerant Pressure Sensor. It may take up to 2 min for all vehicle systems to power down.
2. Test for less than 5 Ω between the low reference circuit terminal 1 and ground.
 - **If 5 Ω or greater**
 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
 2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If less than 5 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**

1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module.
2. Test for infinite resistance between the 5 V reference circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
3. Test for less than 2 Ω in the 5 V reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
- **If greater than 5.2 V**
1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module, vehicle in Service Mode.
2. Test for less than 1 V between the 5 V reference circuit and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
- **If between 4.8 - 5.2 V**
5. Verify the scan tool Engine Control Module A/C High Side Pressure Sensor parameter is less than .25 V.
 - **If .25 V or greater**
 - 1. Vehicle OFF, disconnect the harness connectors at the K20 Engine Control Module, vehicle in Service Mode.
 - 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K20 Engine Control Module.
 - **If less than .25 V**
6. Connect a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
7. Verify the scan tool A/C High Side Pressure Sensor parameter is greater than 4.75 V.
 - **If 4.75 V or less**
 - 1. Vehicle OFF, remove the jumper wire and disconnect the harness connectors at the K20 Engine Control Module.
 - 2. Test for infinite resistance between the signal circuit terminal 3 and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 - 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K20 Engine Control Module.
 - **If greater than 4.75 V**
8. Test or replace the B1 A/C Refrigerant Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P0534: AIR CONDITIONING (A/C) REFRIGERANT CHARGE LOW

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category. cardiagn.com

DTC Descriptor

DTC P0534

Air Conditioning (A/C) Refrigerant Charge Low

Circuit/System Description

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down and dehumidify the cabin and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High Voltage Battery and inverts it to alternating current for the motor. The AC compressor may be activated when any of the following events occur:

- The customer selects Heat and A/C.
- The HVAC system is fan only but the customer selects defrost mode
- The High Voltage Battery Thermal System requests the AC compressor on to help maintain the battery temperature

The Hybrid Powertrain control module 2 (HPCM2) uses values from the A/C refrigerant pressure transducers, ambient air temperature sensor, cabin climate control request, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the HPCM2 to the A/C compressor control module via serial data message.

Conditions for Running the DTC

DTC P0534 Case 1

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor has been off for more than 60 min.
- The AC compressor is commanded on and operating above 500 RPM
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

DTC P0534 Case 2

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor is off for more than 60 min.
- Outside air temperature is greater than 15°C (59°F).
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

DTC P0534 Case 3

- The 12V battery system voltage is equal to or greater than 10.2 V.
- The AC compressor is off for more than 60 min.
- Outside air temperature is greater than 5°C (41°F).
- The following DTCs must not be set: P0071, P0072, P0073. P0074, P0606, P151C, P2516, P2517, P2518

Conditions for Setting the DTC

DTC P0534 Case 1

Low side pressure is less than 90 kPa (13.05 PSI) within 60 sec of the compressor turning on

DTC P0534 Case 2

Low side pressure is less than 150 kPa (21.75 PSI) for outside air temperature greater than 20°C (68°F).

DTC P0534 Case 3

Low side pressure is less than 100 kPa (14.50 PSI) for outside air temperature between 5 - 20°C (41 - 68°F).

Action Taken When the DTC Sets

Active cooling mode for the battery may be disabled.

Conditions for Clearing the DTC

P0534 is a type B DTC.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Install the appropriate air conditioning service center, vehicle in Service Mode.
2. Verify the low side pressure reading on the Air Conditioning Service Center is within 3% of the scan tool A/C Low Side Pressure Sensor parameter.
 - **If the reading is not within 3%**

Refer to **DTC P151C or P2516-P2518**.
 - **If the reading is within 3%**
3. Verify the high side pressure reading on the Air Conditioning Service Center is within 3% of the scan tool A/C High Side Pressure Sensor parameter.
 - **If the reading is not within 3%**

Refer to **DTC P0532 or P0533**.
 - **If the reading is within 3%**
4. Verify the A/C System is operating correctly, refer to **Air Conditioning (A/C) System Performance Test**.
5. Clear all codes in the K114B Hybrid Powertrain Control Module 2 using a scan tool.

6. Verify DTC P0534 does not set while operating the HVAC system under the Conditions for Running the DTC.

- **If the DTC is set**

Replace the K114B Hybrid Powertrain Control Module 2.

- **If the DTC is not set**

7. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup.

DTC P0D69-P0D7F: A/C COMPRESSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P0D69

A/C Compressor Motor Voltage Sensor Performance

DTC P0D6A

A/C Compressor Motor Voltage Sensor Circuit High Voltage

DTC P0D6B

A/C Compressor Motor Voltage Sensor Circuit Low Voltage

DTC P0D71

Electric A/C Compressor Control Module Internal Temperature Sensor Performance

DTC P0D72

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit High Voltage

DTC P0D73

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit Low Voltage

DTC P0D74

Electric A/C Compressor Control Module Internal Temperature Sensor Circuit Intermittent

Circuit/System Description

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High Voltage Battery and inverts it to alternating current for the motor. The AC compressor shall be activated when any of the three following events occur:

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- The customer pushes the AC button

- The HVAC control, in AUTO mode, requests the electric AC compressor on to help in cooling the cabin or removing moisture in the defrost mode
- The High Voltage Battery Thermal System requests the AC compressor on to help maintain the battery temperature

The Hybrid Powertrain control module 2 uses values from the A/C refrigerant pressure transducers, A/C refrigerant thermistor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This speed request message is sent from the Hybrid/EV Powertrain Control Module 2 to the A/C compressor control module via serial data message.

Conditions for Running the DTC

DTC P0D69

- 12 V battery system voltage is greater than 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A; P0D6B, P1EC3, P2534, P2535, P3061, U0111, U016B, or U185A must not be set.

DTC P0D6A

- 12 V battery system voltage is above 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P2534, P2535, or U016B must not be set.

DTC P0D6B

- 12 V battery system voltage is above 10.2 V.
- Main HV battery contactors must be closed.
- DTCs P0AA4, P0AD9, P0C78, P0D5E, P1EC3, P2534, P2535, P3061, or U016B must not be set.

DTC P0D71

- 12 V battery system voltage is above 10.2 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor has been off for more than 6 hours
- Outside air temperature is greater than -7Â°C (19Â°F)
- DTCs P0071, P0072, P0073, P0074, P0532, P0533, P0606, P0D72, P0D73, P0D74, P2534, P2535, or U016B must not be set

DTC P0D72, P0D73

- 12 V battery system voltage is above 10.2 V.
- DTCs P2534, P2535, or U016B must not be set

Conditions for Setting the DTC

DTC P0D69

A/C compressor motor voltage is greater than 33 V.

DTC P0D6A

The A/C compressor high voltage input sensor value is greater than 543.08 V for more than 1 second.

DTC P0D6B

The A/C compressor high voltage input sensor value is less than 28.58 V for more than 1 second.

DTC P0D71

The A/C compressor processor temperature sensor value is greater than 45°C (113°F).

AND

The difference between the A/C compressor processor temperature sensor value and the outside air temperature value is greater than 60°C (108°F).

DTC P0D72

A/C compressor processor temperature sensor value is less than -40°C (-40°F) more than 1 second.

DTC P0D73

A/C compressor processor temperature sensor value is greater than 150°C (302°F) for more than 1 second.

Action Taken When the DTC Sets

The A/C compressor is disabled.

Conditions for Clearing the DTC

These are all type B DTC's

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTC P0071, P0072, P0073, P0074, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P1EC3, P2534, P2535, P3061, U0111, U016B, or U185A are not set.
 - **If any of the DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If none of the DTCs are set**

3. Verify that DTC P0D6B is not set.

- **If DTC P0D6B is set**

Refer to Circuit/System Testing

- **If DTC P0D6B is not set**

4. Verify that DTC P0D69, P0D6A, P0D71, P0D72, P0D73, or P0D74 are not set.

- **If any of the DTCs are set**

1. Program the G1 A/C Compressor and the K114B Hybrid/EV Powertrain Control Module 2 with the latest software calibration.

2. Verify the DTC's do not set

- If any of the DTC's set, replace the affected control module.
- If none of the DTC's are set

3. All OK.

- **If none of the DTCs are set**

5. All OK.

Circuit/System Testing

NOTE: Perform Circuit/System Verification before Circuit/System Testing.

WARNING: Always perform the High Voltage Disabling procedure prior to servicing any High Voltage component or connection. Personal Protection Equipment (PPE) and proper procedures must be followed.

The High Voltage Disabling procedure will perform the following tasks:

- Identify how to disable high voltage.
- Identify how to test for the presence of high voltage.
- Identify condition under which high voltage is always present and personal protection equipment (PPE) and proper procedures must be followed.

Failure to follow the procedures exactly as written may result in serious injury or death.

1. Vehicle OFF, disable the high voltage at the G1 A/C Compressor. Refer to [High Voltage Disabling](#).

2. Disconnect the X2 harness connector at the G1 A/C Compressor and the X5 harness connector at the T24 Battery Charger - DC. Refer to [High Voltage Connectors](#).

3. Test for less than 2 Ω end to end between the 300-Volt Positive and Negative Cable circuit terminals listed below:

- G1 A/C Compressor harness connector terminal A X2 and T24 Battery Charger - DC harness connector terminal A X5.
- G1 A/C Compressor harness connector terminal B X2 and T24 Battery Charger - DC harness connector terminal B X5.
- **If 2 Ω or greater**

Replace the 300-Volt Positive and Negative Cable.

- **If less than 2 Ω**

4. Disconnect the X3 harness connector at the T24 Battery Charger - DC. Refer to [High Voltage Connectors](#).

5. Test for less than 2 Ω between the component terminals listed below:

- T24 Battery Charger - DC connector terminal A X3 and T24 Battery Charger - DC connector terminal A X5.

- T24 Battery Charger - DC connector terminal B X3 and T24 Battery Charger - DC connector terminal B X5.
- **If 2 Ω or greater**

Replace the T24 Battery Charger - DC and the G1 A/C Compressor.

- **If less than 2 Ω**

6. Replace the G1 A/C Compressor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P151C OR P2516-P2518: AIR CONDITIONING (A/C) REFRIGERANT LOW SIDE PRESSURE SENSOR

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P151C

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Not Plausible

DTC P2516

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Performance

DTC P2517

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Circuit Low Voltage

DTC P2518

Air Conditioning (A/C) Refrigerant Low Side Pressure Sensor Circuit High Voltage

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0CE5 00, P0CE6 00, P0606 00, P2517 00, P26A6 00, P2681 00	P2516 00 P2517 00	P0CE7 00, P0606 00, P2518 00, P26A7 00	-
A/C Low Pressure Sensor Signal	P2516 00 P2517 00	P2517 00	P0CE5 00, P0CE7 00, P0606 00, P2518 00, P26A5 00, P26A9 00	P2516 00
Low Reference	-	P2517 00	-	-

Circuit/System Description

The Hybrid/EV Powertrain Control Module 2 monitors the low side refrigerant pressure through the A/C pressure sensor. The Hybrid/EV Powertrain Control Module 2 supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the Hybrid/EV Powertrain Control Module 2 to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low.

Conditions for Running the DTC

P151C

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs may be active: P2517, P2518, P0073, P0072, P0071, P0119, P0118, P0117, P0116, P0531, P0532, P0533, P0606.
- Outside Air Temperature raw and corrected values must have had a chance to settle out. Once this occurs these variables are assigned a status of valid. The vehicle may need to have some time driving in EV mode.
- Coolant temperature must be within 15 degrees of outside air temperature.
- Outside Air Temperature between 0°C (32°F) and 25°C (77°F).
- AC compressor must have been off for an hour since the last time the AC compressor was on.
- High side refrigerant pressure reading must be between 0 kPa and 675 kPa.

P2516

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs may be active: P2517, P2518, P0073, P0072, P0071, P0119, P0118, P0117, P0116, P0606.
- Coolant temperature must be within 15 degrees of outside air temperature.
- AC compressor must have been off for an hour since the last time the AC compressor was on.
- AC compressor must be turned on for one minute. (This may require the service technician to select an HVAC mode that causes the AC compressor to run).

P2517 or P2518

- Vehicle ON
- 12 V battery system voltage above 10.25 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.

Conditions for Setting the DTC

DTC P151C

- The A/C low side Refrigerant Pressure reading and the A/C high side Refrigerant Pressure reading differ by more than 200 kPa (29 psi).
- Loss of HVAC Control Module communication

DTC P2516

The difference between the A/C low side pressure Sensor before compressor on and after compressor on changes less than 50 kPa (7 psi) over a 15 second period.

DTC P2517

The Hybrid/EV Powertrain Control Module 2 detects a short to ground or open at the A/C low side pressure sensor signal circuit.

DTC P2518

The Hybrid/EV Powertrain Control Module 2 detects a short to voltage at the A/C low side pressure sensor signal circuit.

Action Taken When the DTC Sets

These are type B DTCs.

Conditions for Clearing the DTC

These are type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTCs U0140 and U184B are not set.
 - **If any of the DTCs are set**
Refer to **DTC U0100-U02FF** , or **DTC U184B** .
 - **If none of the DTCs are set**
3. Refer to Circuit/System Testing.

Circuit/System Testing

1. Vehicle OFF, all vehicle systems OFF, scan tool disconnected, and key removed from vehicle, disconnect the harness connector at the B1C A/C Low Side Pressure Sensor. It may take up to 10 min for all vehicle systems to power down.
2. Test for less than 10 Ω between the low reference circuit terminal 1 and ground.
 - **If 10 Ω or greater**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2.

2. Test for less than 2 Ω in the low reference circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
- **If less than 10 Ω**
3. Vehicle in Service Mode.
4. Test for 4.8 - 5.2 V between the 5 V reference circuit terminal 2 and ground.
 - **If less than 4.8 V**
 1. Vehicle OFF, disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the terminals listed below and ground.
 - Terminal 63
 - Terminal 64
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the 5 V reference circuit terminal 63 end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If greater than 5.2 V**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 2. Test for less than 1 V between the terminals listed below and ground.
 - Signal circuit terminal 25
 - Signal circuit terminal 31
 - Signal circuit terminal 50
 - 5 V reference circuit terminal 63
 - 5 V reference circuit terminal 64
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If between 4.8 - 5.2 V**
5. Verify the scan tool Hybrid/EV Powertrain Control Module 2 A/C Low Side Pressure Sensor parameter is less than 0.1 V.
 - **If 0.1 V or greater**
 1. Vehicle OFF, disconnect the harness connector at the K114B Hybrid/EV Powertrain Control Module 2, vehicle in Service Mode.
 2. Test for less than 1 V between the signal circuit terminal 3 and ground.
 - If 1 V or greater, repair the short to voltage on the circuit.
 - If less than 1 V, replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If less than 0.1 V**
6. Install a 3 A fused jumper wire between the signal circuit terminal 3 and the 5 V reference circuit terminal 2.
7. Verify the scan tool A/C Low Side Pressure Sensor parameter is greater than 4.8 V.
 - **If 4.8 V or less**
 1. Vehicle OFF, remove the jumper wire and disconnect the X1 harness connector at the K114B Hybrid/EV Powertrain Control Module 2.
 2. Test for infinite resistance between the signal circuit and ground.
 - If less than infinite resistance, repair the short to ground on the circuit.
 - If infinite resistance
 3. Test for less than 2 Ω in the signal circuit end to end.
 - If 2 Ω or greater, repair the open/high resistance in the circuit.
 - If less than 2 Ω , replace the K114B Hybrid/EV Powertrain Control Module 2.

- If greater than 4.8 V

8. Test or replace the B1C A/C Low Side Pressure Sensor.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

DTC P154F: ELECTRIC A/C COMPRESSOR MOTOR INPUT CURRENT- POSITIVE CONTACTOR STATE NOT PLAUSIBLE

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptors

DTC P154F

Electric A/C Compressor motor Input Current- Positive Contactor State Not Plausible

Circuit/System Description

The hybrid powertrain control module 2 receives serial data messages from the A/C compressor. If the electrical current reported by the compressor is not logical based on the currently commanded state, the hybrid powertrain control module 2 sets the DTC.

Conditions for Running the DTC

- Vehicle ON
- 12 V battery system voltage above 10.2 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs are set: P0532, P0533, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A, P0D6B, P15CA, P1EC3, P1F0A, P1F0C, P1F0D, P2534, P2535, P3061, U0111, U016B, or U185A.
- The time since the high voltage contactors have been commanded opened or closed is greater than 1 s.
- Hybrid/EV Powertrain Control Module 2 monitors the data from the A/C compressor every 250 ms when the above conditions are met.

Conditions for Setting the DTC

DTC P154F is a Type B DTC.

Condition 1

- The high voltage battery contactors are commanded open.
- Electrical current is reported via serial data from the A/C compressor.

Condition 2

- The high voltage battery contactors are commanded closed.
- The A/C compressor is commanded OFF (0 RPM).
- Electrical current is reported via serial data from the A/C compressor.

OR

- The RPM reported via serial data from the A/C compressor is greater than 60 RPM.

Condition 3

- The high voltage battery contactors are commanded closed.
- The high voltage battery is between 300 - 410 V.
- The A/C compressor is commanded ON.
- The RPM reported via serial data from the A/C compressor is between 1000 - 8600 RPM.
- The A/C refrigerant high side pressure reported via serial data from the ECM is between 200 - 2300 kPa (29 - 334 PSI).
- Electrical current reported via serial data from the A/C compressor is less than 0.2 A or greater than 27 A.

Action Taken When the DTC Sets

DTC P154F is a Type B DTC.

Conditions for Clearing the DTC

DTC P154F is a Type B DTC.

Diagnostic Aids

These DTCs may be set during a stall.

Reference Information

Schematic Reference

Hybrid/EV Controls Schematics

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Circuit/System Verification

1. Verify DTCs P0532, P0533, P0AA4, P0ABB, P0ABC, P0ABD, P0AD9, P0C78, P0D5E, P0D6A, P0D6B, P15CA, P1EC3, P1F0A, P1F0C, P1F0D, P2534, P2535, P3061, U0111, U016B, or U185A. are not set.
 - **If any of the DTCs are set**

Refer to [Diagnostic Trouble Code \(DTC\) List - Vehicle](#) .
 - **If none of the DTCs are set**
2. Replace the G1 A/C Compressor.
3. Verify DTC P154F does not set while operating the vehicle within the Conditions for Running the DTC.
 - **If the DTCs sets**

Replace the K114B Hybrid/EV Powertrain Control Module 2.
 - **If the DTCs does not set**
4. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the diagnostic procedure.

[HVAC Component Replacement Reference](#)

[Control Module References](#) for control module replacement, programming and setup.

DTC P156A-P156C: AIR CONDITIONING (A/C) PRESSURE TOO HIGH WHEN A/C OFF, TOO LOW WHEN A/C ON

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of the diagnostic category.

DTC Descriptors

DTC P156A

Air Conditioning (A/C) Pressure Too High when A/C Off

DTC P156B

Air Conditioning (A/C) Pressure Too Low when A/C On

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
5 V Reference	P0452, P0532, P0641	P0532	P0453, P0533, P0641	-
Signal	P0532	P0532	P0533	P0531, P156A, P156B
Low Reference	-	P0533	-	-

Circuit/System Description

The engine control module monitors the high side refrigerant pressure through the high side A/C refrigerant pressure sensor. The engine control module supplies a 5 V reference and a low reference to the sensor. Changes in the A/C refrigerant pressure cause the sensor signal to the engine control module to vary. When the pressure is high, the signal voltage is high. When the pressure is low, the signal voltage is low. When pressure is high, the engine control module commands the cooling fans on.

If the engine control module detects the refrigerant pressure sensor signal is not logical based on the current operating conditions, the engine control module sets the DTC.

Conditions for Running the DTC

P156A

- Vehicle ON
- None of these DTCs are set: P0532, P0533, or U016B
- The compressor has been OFF for more than 20 s.
- The ECM monitors the A/C high side pressure every 100 ms when the above conditions are met.

P156B

- Vehicle ON
- None of these DTCs are set: P0532, P0533, or U016B
- The compressor has been ON for more than 10 s.
- The ECM monitors the A/C high side pressure every 100 ms when the above conditions are met.

Conditions for Running the DTC

P156A

- P156A is a type B DTC
- The ECM detects the A/C high side pressure is too high based on the current operating conditions.

P156B

- P156B is a type B DTC
- The ECM detects the A/C high side pressure is too low based on the current operating conditions.

Action Taken When the DTC Sets

P156A and P156B are type B DTCs

Conditions for Clearing the DTC

P156A and P156B are type B DTCs

Diagnostic Aids

A malfunction within the refrigerant system causing can cause these DTCs to set.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Special Tools

GE-48800 CoolTech A/C Recharge Machine

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify no other DTCs are set.
 - **If any other DTCs are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If no other DTCs are set**

3. Install the **GE-48800** CoolTech A/C Recharge Machine.
4. Verify the high side pressure reading on the Air Conditioning Service Center is within 10% of the scan tool ECM A/C High Side Pressure Sensor parameter.

- **If the reading is not within 10%**

Refer to [**DTC P0532 or P0533**](#).

- **If the reading is within 10%**

5. Refer to [**Air Conditioning \(A/C\) System Performance Test**](#) .

Repair Instructions

Perform the [**Diagnostic Repair Verification**](#) after completing the repair.

DTC P15C6 OR P15C8-P15CB: ELECTRIC A/C COMPRESSOR

Diagnostic Instructions

- Perform the [**Diagnostic System Check - Vehicle**](#) prior to using this diagnostic procedure.
- Review [**Strategy Based Diagnosis**](#) for a overview of the diagnostic approach.
- [**Diagnostic Procedure Instructions**](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC P15C6

Electric A/C Compressor Speed Request Signal Message Counter Incorrect

DTC P15C8

Electric A/C Compressor Data Message Counter Incorrect

DTC P15C9

Electric A/C Compressor Status Message Counter Incorrect

DTC P15CA

Electric A/C Compressor Sensors Signal Message Counter Incorrect

DTC P15CB

Electric A/C Compressor Sensors Status Message Counter Incorrect

Circuit/System Description

The hybrid powertrain control module 2 receives serial data messages from the A/C compressor. If the message counter from the A/C compressor is not incrementing based on the currently commanded state, the hybrid powertrain control module 2 sets the DTC.

Conditions for Running the DTC

- Vehicle ON
- 12 V battery system voltage above 10.2 V.
- Hybrid/EV Powertrain Control Module 2 is awake and communicating.
- None of these DTCs are set: P2534, P2535, or U016B
- The A/C compressor is active.
- Hybrid/EV Powertrain Control Module 2 monitors the data from the A/C compressor every 100 ms when the above conditions are met.

Conditions for Setting the DTC

The hybrid powertrain control module 2 detects the message counter from the A/C compressor is not being updated.

Action Taken When the DTC Sets

DTCs P15C6, P15C8, P15C9, P15CA, and P15CB are Type B DTCs.

Conditions for Clearing the DTC

DTCs P15C6, P15C8, P15C9, P15CA, and P15CB are Type B DTCs.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

- **Automatic HVAC Description and Operation**
- **Hybrid/EV Cooling System Description and Operation**

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Verify DTCs P2534, P2535, or U016B are not set.

- **If DTC P2534, P2535, or U016B are set**

Refer to **Diagnostic Trouble Code (DTC) List - Vehicle** .

- **If DTC P2534, P2535, or U016B are not set**

2. Replace the G1 A/C Compressor.

3. Verify DTCs P15C6, P15C8, P15C9, P15CA, or P15CB do not set while operating the vehicle within the Conditions for Running the DTC.

- **If any of the DTCs are set**

Replace the K114B Hybrid/EV Powertrain Control Module 2.

- **If none of the DTCs are set**

4. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the diagnostic procedure.

Control Module References for control module replacement, programming and setup.

DTC P1F0A-P1F0D: A/C COMPRESSOR MOTOR, ELECTRIC A/C COMPRESSOR CONTROL MODULE

Diagnostic Instructions

- Perform the **Diagnostic System Check - Vehicle** prior to using this diagnostic procedure.
- Review **Strategy Based Diagnosis** for an overview of the diagnostic approach.
- **Diagnostic Procedure Instructions** provides an overview of each diagnostic category.

DTC Descriptors

DTC P1F0A

A/C Compressor Motor Speed Performance

DTC P1F0B

A/C Compressor Motor Start-Up Current Performance

DTC P1F0C

Electric A/C Compressor Control Module A/C Compressor Motor Current Feedback Circuit Low Voltage

DTC P1F0D

Electric A/C Compressor Control Module A/C Compressor Motor Current Feedback Circuit High Voltage

Circuit/System Description

The A/C compressor function is to provide refrigerant flow in the A/C refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes High Voltage direct current from the vehicle's High voltage battery and inverts it to alternating current for the motor. The A/C compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button
- The HVAC control, in AUTO mode, requests the electric A/C compressor on to help in cooling the cabin or removing moisture in the defrost mode
- The High Voltage Battery Thermal System requests the A/C compressor on to help maintain the battery temperature

The Hybrid/EV powertrain control module 2 uses values from the A/C refrigerant pressure transducers, A/C refrigerant thermistor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the Hybrid/EV powertrain control module 2 to the A/C compressor control module via serial data message.

A/C Compressor has a motor start up procedure that can take a variable length of time to run to bring the motor up to requested speed. Length of time is dependent on external conditions such as underhood temperature and high side pressure. In hotter conditions, the motor start up time will be longer. The A/C compressor control module monitors an internal parameter known as the DC link current which is based off DC input current. It is not possible to measure this parameter externally.

Conditions for Running the DTC

DTC P1F0A

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0B

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0C

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

DTC P1F0D

- 12 V battery system voltage is above 10.25 V.
- Vehicle is in Run Mode or Charging Mode
- Compressor is in start up mode

Conditions for Setting the DTC

DTC P1F0A

- A/C compressor control module temperature is greater than 85°C (185°F) and compressor motor speed does not reach to 1800 RPM within 20 s after the start of spinning
- A/C compressor control module temperature is less than or equal to 85°C and A/C compressor motor speed does not reach to 1800 RPM.

DTC P1F0B

Any A/C compressor control module phase current (U/V/W) greater than or equal to -1 A during initial motor startup process

DTC P1F0C

A/C compressor control module DC link Current is less than 2.5 A for 6 s

DTC P1F0D

A/C compressor control module DC link Current is greater than 36.7 A for 6 s

Action Taken When the DTC Sets

The A/C compressor control module is disabled but will retry once the compressor speed request goes to 0 RPM and a new speed request greater than 0 RPM is sent.

Conditions for Clearing the DTC

These are type B DTC's

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Automatic HVAC Description and Operation

Electrical Information Reference

- **Circuit Testing**
- **Connector Repairs**
- **Testing for Intermittent Conditions and Poor Connections**
- **Wiring Repairs**

DTC Type Reference

Powertrain Diagnostic Trouble Code (DTC) Type Definitions

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify that DTCs P1F0A-P1F0D are not set.
 - **If any of the DTCs are set**
 1. Program the G1 A/C Compressor and the K114B Hybrid/EV Powertrain Control Module 2 with the latest software calibration.
 2. Verify the DTCs do not set
 - If any of the DTCs set, replace the affected control module.
 - If none of the DTCs are set
 3. All OK.
 - **If none of the DTCs are set**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

- **HVAC Component Replacement Reference**
- **Control Module References** for control module replacement, programming and setup

SYMPTOMS - HVAC SYSTEMS - AUTOMATIC

NOTE: The following steps must be completed before using the symptom tables:

1. Perform the **Diagnostic System Check - Vehicle** before using the Symptom Tables in order to verify that all of the following are true:
 - There are no DTCs set.
 - The control modules can communicate via the serial data link.
2. Review the system operation in order to familiarize yourself with the system functions. Refer to **Automatic HVAC Description and Operation**.

Visual/Physical Inspection

- Inspect for aftermarket devices which may affect the operation of the HVAC System. Refer to **Checking Aftermarket Accessories**.
- Inspect the easily accessible or visible system components for obvious damage or conditions which may cause the symptom.
- Verify the A/C compressor turns freely and is not seized.

- Verify that the customer is using the correct key to enable personalization and is not inadvertently activating auxiliary HVAC controls.
- The A/C compressor will not operate in cold outside air temperatures.
- The following conditions may cause window fogging:
 - Wet carpet or mats
 - High humidity
 - Interior water leak
 - Blocked A/C evaporator drain tube
 - Maximum passenger capacity
 - Blocked body pressure relief valves
- Inspect the air distribution system for causes of reduced air flow:
 - Obstructed or dirty passenger compartment air filter, if equipped
 - Blocked or damaged air inlet or outlet vents

Intermittent

Faulty electrical connections or wiring may be the cause of intermittent conditions. Refer to [Testing for Intermittent Conditions and Poor Connections](#) .

Symptom List

Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:

HVAC System Malfunction

HVAC SYSTEM MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

Diagnostic Aids

Check the following mechanical fault sources:

- Air distribution box
- Air distribution hoses/air distribution ducts

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

Electrical Information Reference

- [Circuit Testing](#)
- [Connector Repairs](#)
- [Testing for Intermittent Conditions and Poor Connections](#)
- [Wiring Repairs](#)

[Control Module References](#) for scan tool information

Circuit/System Verification

NOTE: Check for bulletins before proceeding.

1. Vehicle in Service Mode.
2. Verify every applicable scan tool switch parameter changes when pressing the appropriate switch on the A20 Radio/HVAC Controls.
 - **If any parameter does not change**
Replace the A20 Radio/HVAC Controls.
 - **If all parameters change**
3. Verify the blower motor operates properly with the blower motor switch in each speed position.
 - **If the blower motor does not operate properly in each speed position**
Refer to [DTC B0193](#).
 - **If the blower motor operates properly in each speed position**
4. Verify every HVAC door moves correctly when pressing the appropriate switch.
 - **If any HVAC door does not move correctly**
Refer to [DTC B0223, B0233, B023A, or B0408](#).
 - **If all HVAC doors move correctly**
5. Install the appropriate ACR Air Conditioning Service Center, Vehicle in Service Mode
6. Verify the high side pressure on the gauge is within 10% of the scan tool A/C High Side Pressure Sensor parameter.
 - **If the A/C High Side Pressure Sensor parameter is not within 10%**
Refer to [DTC P0532 or P0533](#).
 - **If the A/C High Side Pressure Sensor parameter is within 10%**
7. Verify the A/C High Side Pressure Sensor parameter is between 269-2929 kPa (39-425 PSI).
 - **If the reading is not between 269-2929 kPa (39-425 PSI)**
Refer to [Air Conditioning \(A/C\) System Performance Test](#)
 - **If the reading is between 269-2929 kPa (39-425 PSI)**
8. Verify the low side pressure on the gauge is within 10% of the scan tool A/C Low Side Pressure Sensor parameter.
 - **If the A/C Low Side Pressure Sensor parameter is not within 10%**
Refer to [DTC P151C or P2516-P2518](#).
 - **If the A/C Low Side Pressure Sensor parameter is within 10%**
9. Verify the scan tool parameters listed below are within 10% of ambient temperature.
 - Lower Left Duct Air Temperature Sensor
 - Upper Left Duct Air Temperature Sensor
 - **If not within 10% of ambient temperature**
Refer to [DTC B0173 or B0178](#).
 - **If within 10% of ambient temperature**

NOTE: If the vehicle is equipped with RPO CE1, proceed to step 11.

10. Verify the scan tool parameters listed below are within 10% of actual conditions.

- Passenger Compartment Humidity
- Passenger Compartment Humidity Sensor Temperature
- Passenger Compartment Windshield Temperature
- **If not within 10% of actual conditions**

Refer to [DTC B018A, B048C, B048E, or B1395](#).

- **If within 10% of actual conditions**

11. Vehicle ON, A/C system ON.

12. Verify cool air flows from the ducts with the temperature control in the coldest position.

- **If the air is not cool**

Refer to [Air Conditioning \(A/C\) System Performance Test](#)

- **If the air is cool**

13. Vehicle in Service Mode.

14. Verify the G36 Auxiliary Heater Coolant Pump turns On and Off when commanded with a scan tool.

- **If the G36 Auxiliary Heater Coolant Pump does not turn On and Off**

Refer to [DTC B3844](#).

- **If the G36 Auxiliary Heater Coolant Pump turns On and Off**

15. Vehicle ON, verify the K10 Coolant Heater Control Module is operating properly.

- **If the K10 Coolant Heater Control Module is not operating properly**

Refer to [DTC B048E](#)

- **If the K10 Coolant Heater Control Module is operating properly**

16. Verify warm air flows from the ducts with the temperature control in the warmest position.

- **If the air is not warm**

Refer to [Heating Performance Diagnostic](#) .

- **If the air is warm**

17. All OK.

Repair Instructions

Perform the [Diagnostic Repair Verification](#) after completing the repair.

- [HVAC Component Replacement Reference](#)
- [Control Module References](#) for control module replacement, programming and setup

AUXILIARY HEATER COOLANT PUMP MALFUNCTION

Diagnostic Instructions

- Perform the [Diagnostic System Check - Vehicle](#) prior to using this diagnostic procedure.
- Review [Strategy Based Diagnosis](#) for an overview of the diagnostic approach.
- [Diagnostic Procedure Instructions](#) provides an overview of each diagnostic category.

DTC Descriptor

DTC B3844 01

Engine Coolant Circulation Pump Circuit Short to Battery

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DTC B3844 06

Diagnostic Fault Information

Circuit	Short to Ground	Open/High Resistance	Short to Voltage	Signal Performance
Coolant Pump Relay Coil Control	B3844 06, 2	B3844 06, 1	B3844 01, 1	-
Coolant Pump Relay Controlled Output	B3844 06, 1	1	2	-
Coolant Pump Ground	-	1	-	-
1. Coolant Pump inoperative 2. Coolant pump always on				

Circuit/System Description

The coolant heater pump is controlled by a relay. When operating conditions exist that requires the coolant heater to operate, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay. The coolant pump then circulates the coolant within the coolant heater system.

Reference Information

Schematic Reference

HVAC Schematics

Connector End View Reference

COMPONENT CONNECTOR END VIEWS - INDEX

Description and Operation

Automatic HVAC Description and Operation

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- **Wiring Repairs**

Scan Tool Reference

Control Module References for scan tool information

Circuit/System Verification

1. Vehicle in Service Mode.
2. Verify the G17 Heater Coolant Pump operates when commanding the Auxiliary Coolant Pump On and Off with a scan tool.
 - **If the G17 Heater Coolant Pump does not operate**
Refer to **DTC B3844**.
 - **If the G17 Heater Coolant Pump operates**
3. All OK.

Repair Instructions

Perform the **Diagnostic Repair Verification** after completing the repair.

AFTERBLOW ENABLING

Afterblow is a feature that dries the evaporator core by operating the blower motor after the engine is turned off. This aids in reducing microbial growth that can create undesirable odors.

The vehicle does not come equipped with the afterblow feature turned on. If the afterblow feature is required due to an odor concern, it must be enabled by using the scan tool.

Use the following procedure to enable the afterblow feature:

1. Connect the Scan Tool.
2. Ignition ON/ Vehicle in Service Mode
3. Select Module Diagnostics.
4. Select HVAC Control Module.
5. Select Configuration/Reset Functions.
6. Select HVAC Afterblow Configuration.

When afterblow has been enabled, the following conditions must be met for the HVAC control module to operate afterblow:

- The vehicle must be turned OFF.
- The outside air temperature must be at least 11Â°C (52Â°F) when the compressor was last operating before the engine was turned OFF.
- The A/C compressor must have operated for more than 2 minutes before the engine was turned OFF.
- The system voltage must be above 12 V.

Once the above conditions have been met, the blower motor will operate at a low blower speed, following the sequence below up to 5 times:

1. The blower motor will be OFF for 7 - 11 minutes.
2. The blower motor will operate for 20 - 60 seconds.

ACTUATOR RECALIBRATION

Preferred Method (with Scan Tool)

NOTE: Do not operate any HVAC controls while the HVAC control module is calibrating as this may interrupt the process. If interrupted, improper HVAC performance will result.

1. Using a scan tool, perform the HVAC Actuators Learn in the HVAC Control Module.
2. Follow the scan tool directions to complete the procedure.
3. Operate the system and verify that no DTCs have set as current DTCs.
4. If DTC B101E 4B is set after attempting the actuator recalibration procedure, perform the following:
 1. Verify which actuator does not have a scan tool learn status parameter status of complete.
 2. Verify the unlearned actuator is physically rotating - A common cause of DTC B101E 4B is an actuator that is electrically OK but fails to physically rotate (e.g. stripped gears).
 3. If the unlearned actuator is not physically rotating, replace the actuator, otherwise replace the HVAC control module.

Alternate Method (without Scan Tool)

NOTE: Do not operate any HVAC controls while the HVAC control module is calibrating as this may interrupt the process. If interrupted, improper HVAC performance will result.

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1. Ignition OFF/ Vehicle OFF.

2. Remove the HVAC control module fuse for a minimum of 10 s.
3. Install the HVAC control module fuse.
4. Start the vehicle.
5. Wait 40 s for the HVAC control module to self-calibrate.

REPAIR INSTRUCTIONS

HEATER AND AIR CONDITIONING REMOTE CONTROL REPLACEMENT

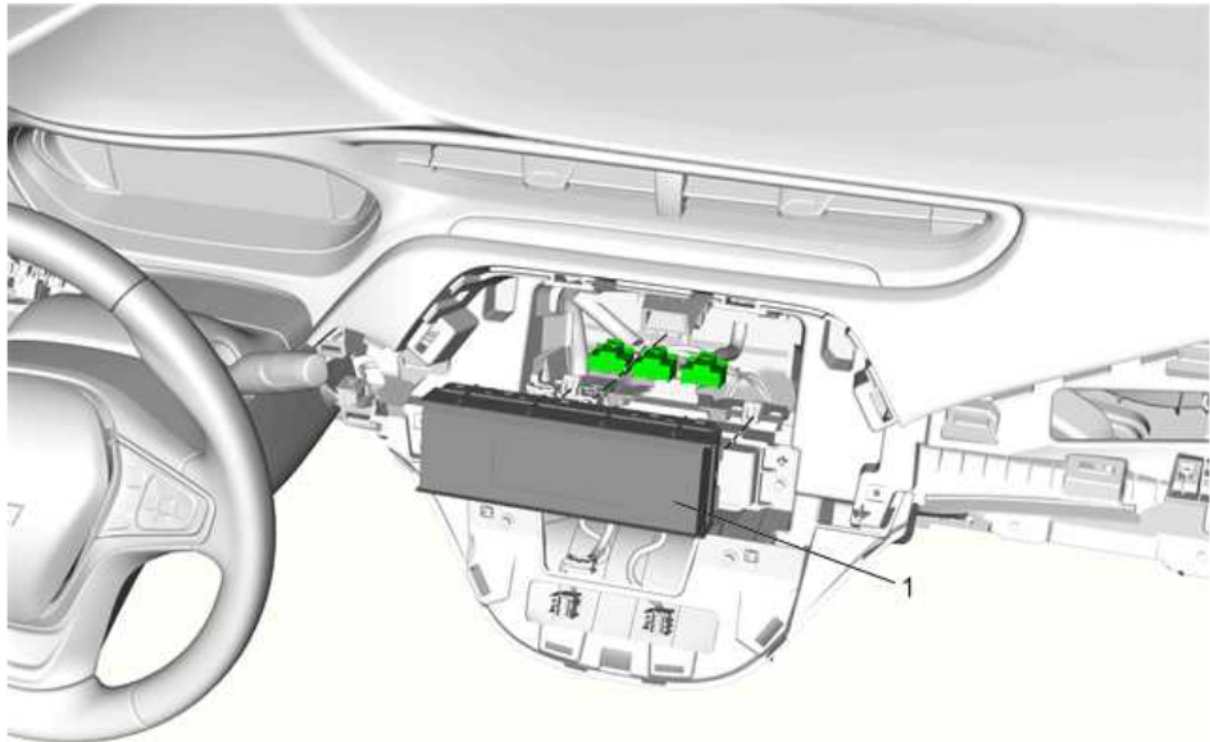


Fig. 6: Heater and Air Conditioning Remote Control

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Trim Plate Replacement</u>	
1	Heater and Air Conditioning Remote Control Procedure 1. Release the retaining tabs. 2. Disconnect the electrical connector. 3. Program the heater and air conditioning remote control. <u>Control Module References</u>

AIR CONDITIONING WIRING HARNESS REPLACEMENT

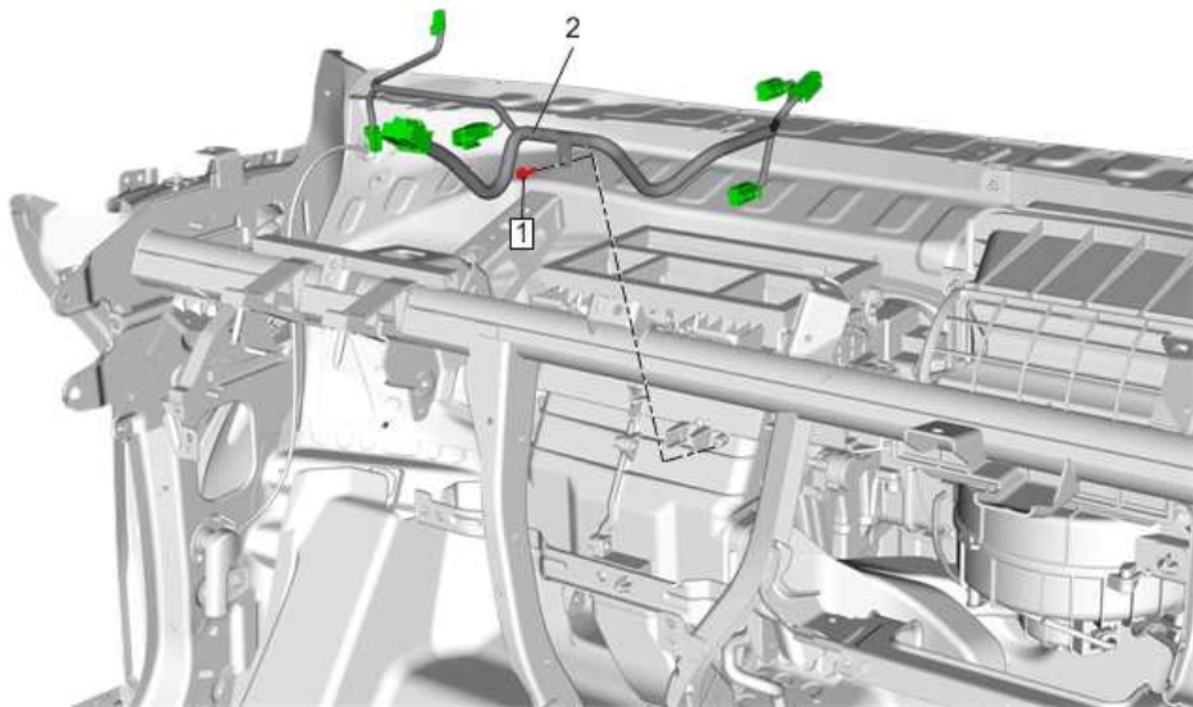


Fig. 7: Air Conditioning Wiring Harness
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Instrument Panel Assembly Replacement</u> - Loosen the tie bar, if necessary. <u>Instrument Panel Tie Bar Replacement</u>	
1	Air Conditioning Wiring Harness Screw CAUTION: <u>Fastener Caution</u> Tighten 2.5 N.m (22 lb in)
2	Air Conditioning Wiring Harness Procedure Disconnect the electrical connectors.

AIR INLET VALVE ACTUATOR REPLACEMENT

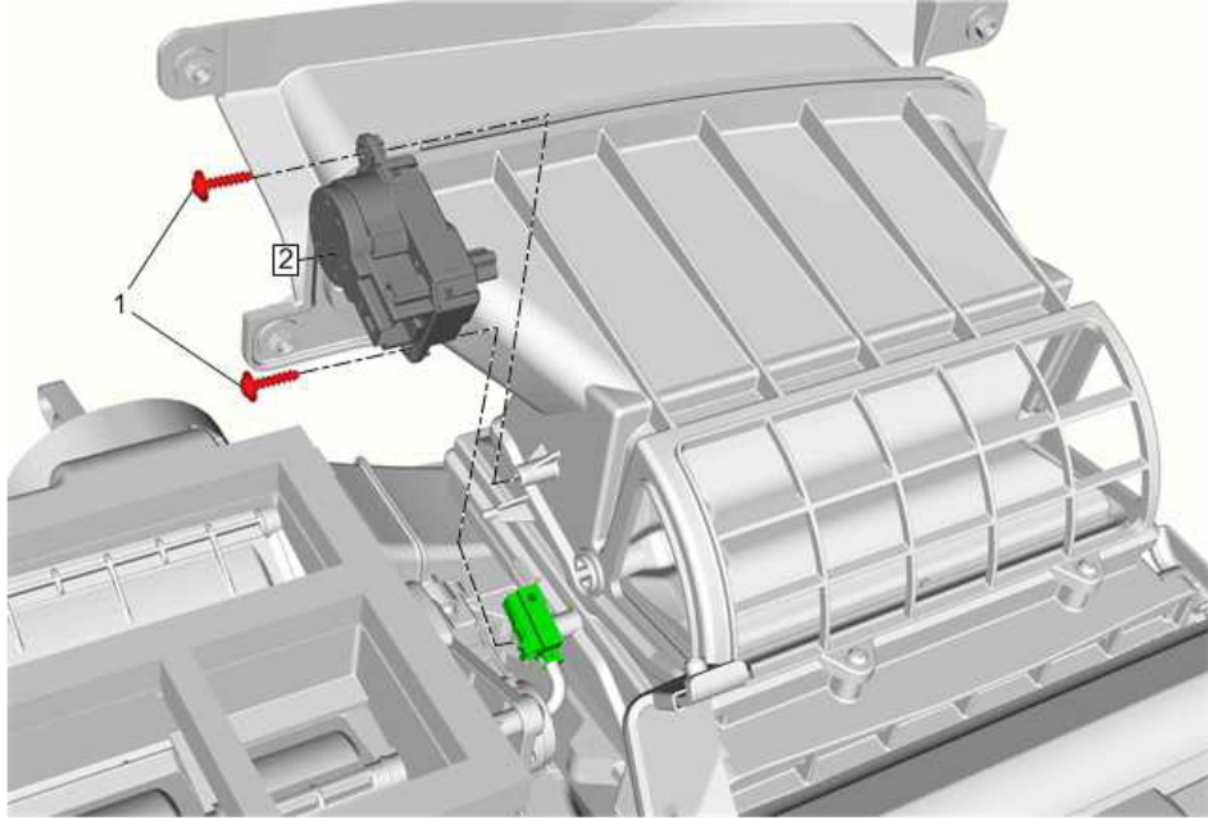


Fig. 8: Air Inlet Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Remove the air inlet housing. Air Inlet Housing Replacement	
1	Air Inlet Valve Actuator Fastener (Qty: 2) CAUTION: Fastener Caution Tighten 2.5 N.m (22 lb in)
2	Air Inlet Valve Actuator Procedure Perform the programming and setup. Actuator Recalibration

MODE VALVE ACTUATOR REPLACEMENT

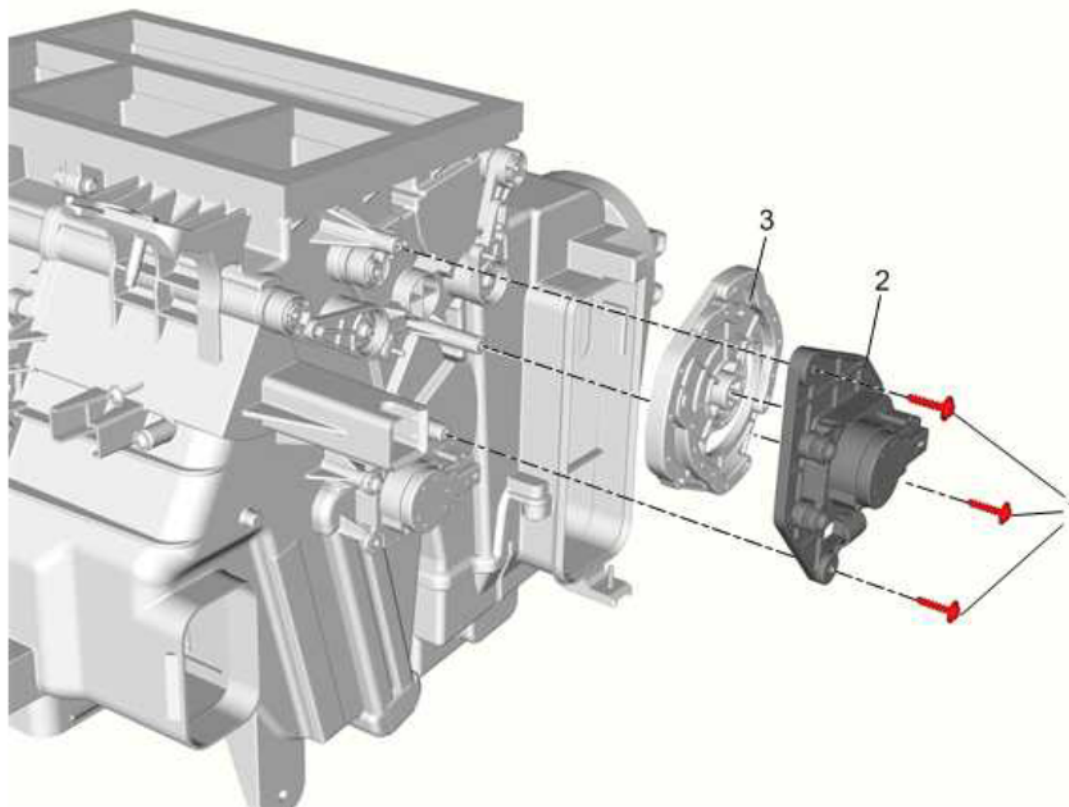


Fig. 9: Mode Valve Actuator

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Heater and Air Conditioning Evaporator Case Replacement</u>	
1	Mode Valve Actuator Bolt (Qty: 3) CAUTION: <u>Fastener Caution</u> Tighten 2.5 N.m (22 lb in)
2	Mode Valve Actuator Procedure 1. Mark cam and levers for proper installation. 2. Disconnect the electrical connector. 3. Reposition the air conditioning module wiring harness. 4. <u>Actuator Recalibration</u>
3	Mode Control Cam Procedure Remove the mode control cam from the actuator.

MODE CONTROL CAM REPLACEMENT

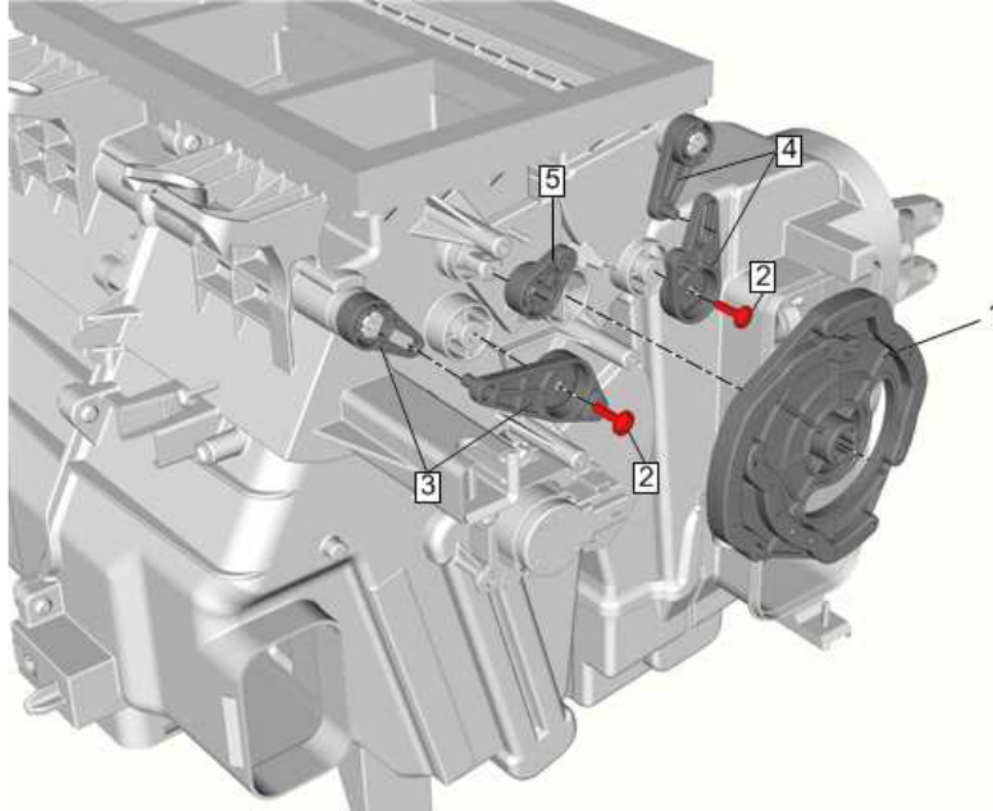


Fig. 10: Mode Control Cam

Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Mode Valve Actuator Replacement</u>	
1	Mode Control Cam Procedure 1. Mark the cam and levers for proper installation. 2. Lubricate the mode control cam in order to assure proper operation. Use Polylub GLY 801™, or equivalent.
2	Lever Screw (Qty: 2) CAUTION: <u>Fastener Caution</u> Tighten 2.5 N.m (22 lb in)
3	Floor Air Valve Lever
4	Defroster Valve Lever
5	Vent Valve Gear

TEMPERATURE VALVE ACTUATOR REPLACEMENT

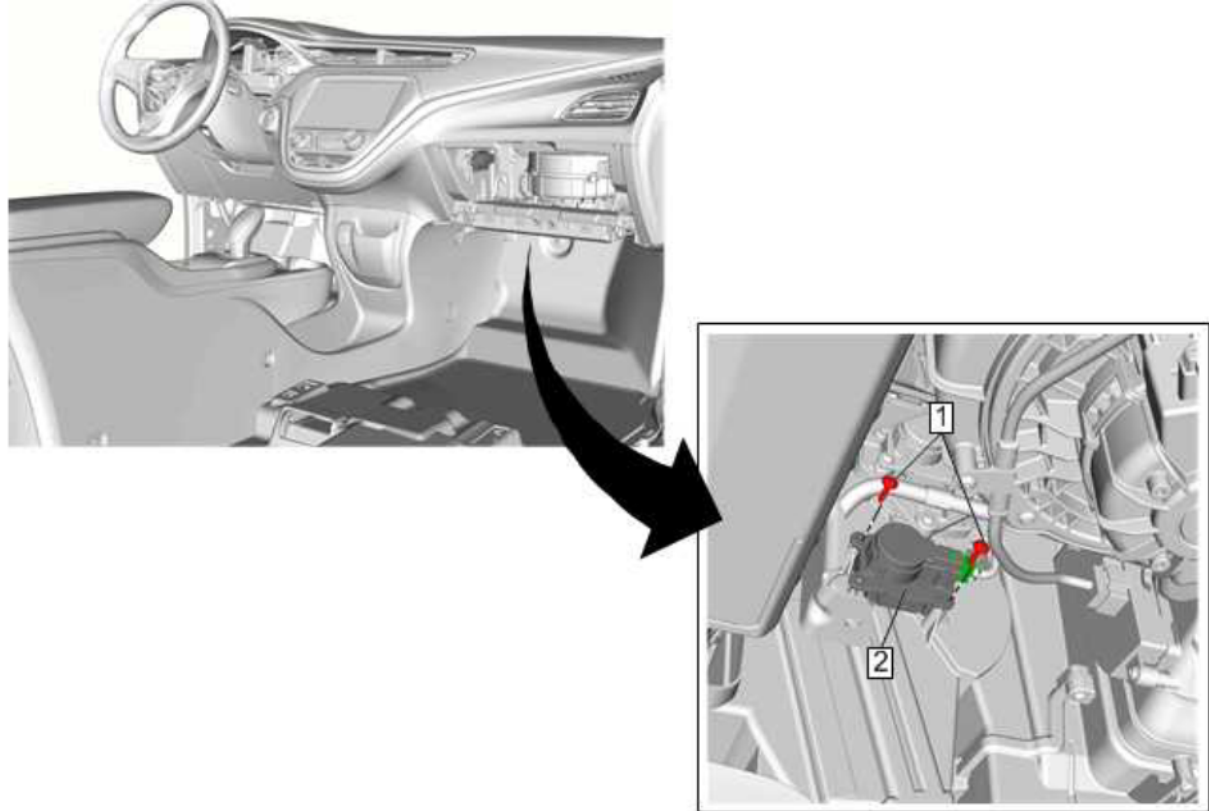


Fig. 11: Temperature Valve Actuator
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure <u>Instrument Panel Compartment Replacement</u>	
1	Temperature Valve Actuator Fastener (Qty: 2) CAUTION: <u>Fastener Caution</u> Tighten 2.5 N.m (22 lb in)
2	Temperature Valve Actuator Procedure 1. Disconnect the electrical connector. 2. <u>Actuator Recalibration</u>

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - UPPER

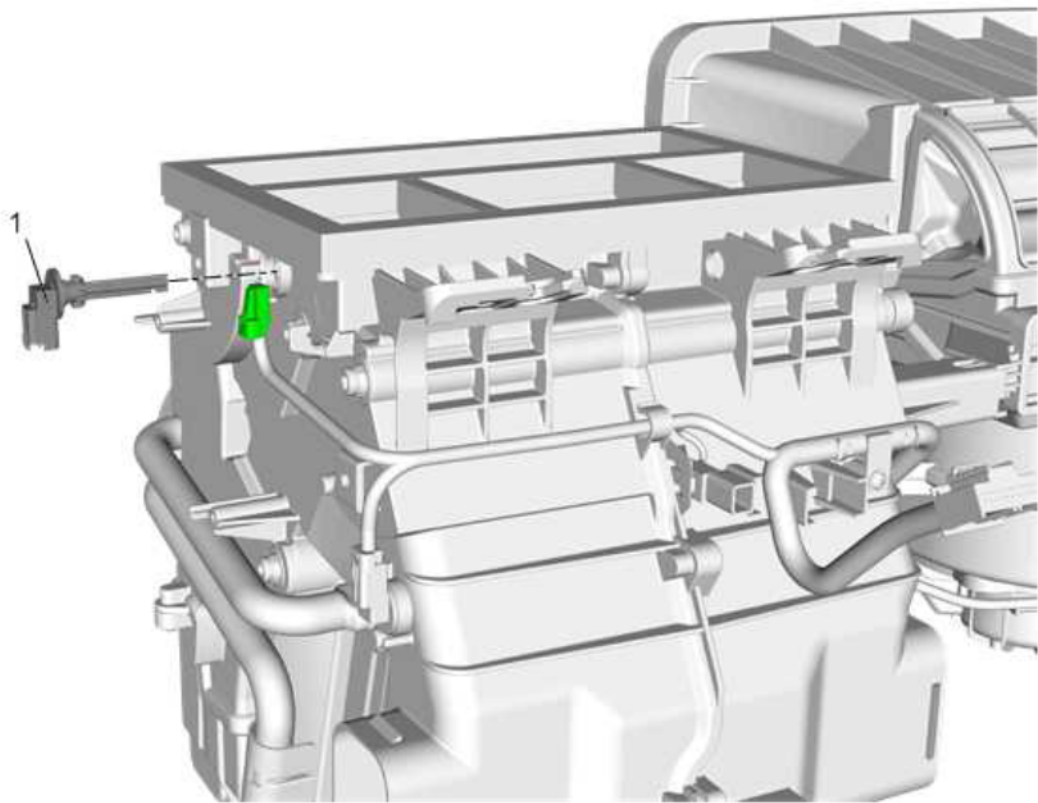


Fig. 12: Duct Air Temperature Sensor - Upper
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Instrument Panel Lower Airbag Bracket Replacement</u> <u>Floor Front Air Outlet Duct Replacement - Left Side</u>	
1	Duct Air Temperature Sensor - Upper Procedure 1. Disconnect the electrical connector. 2. Rotate the sensor counter clockwise to remove.

DUCT AIR TEMPERATURE SENSOR REPLACEMENT - LOWER

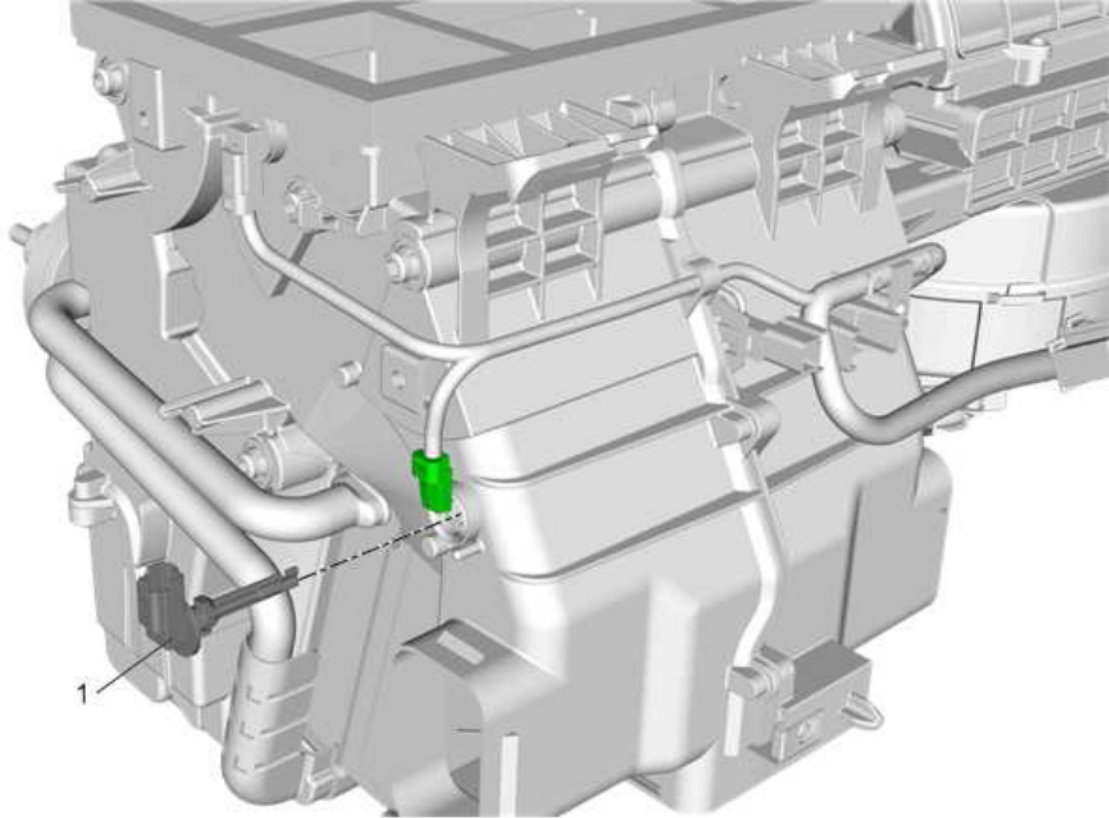


Fig. 13: Duct Air Temperature Sensor - Lower
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedures <u>Instrument Panel Lower Airbag Bracket Replacement</u> <u>Floor Front Air Outlet Duct Replacement - Left Side</u>	
1	Duct Air Temperature Sensor - Lower Procedure 1. Disconnect the electrical connector. 2. Rotate the sensor clockwise to remove.

**INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT
 (WITH FRONT VIEW CAMERA)**

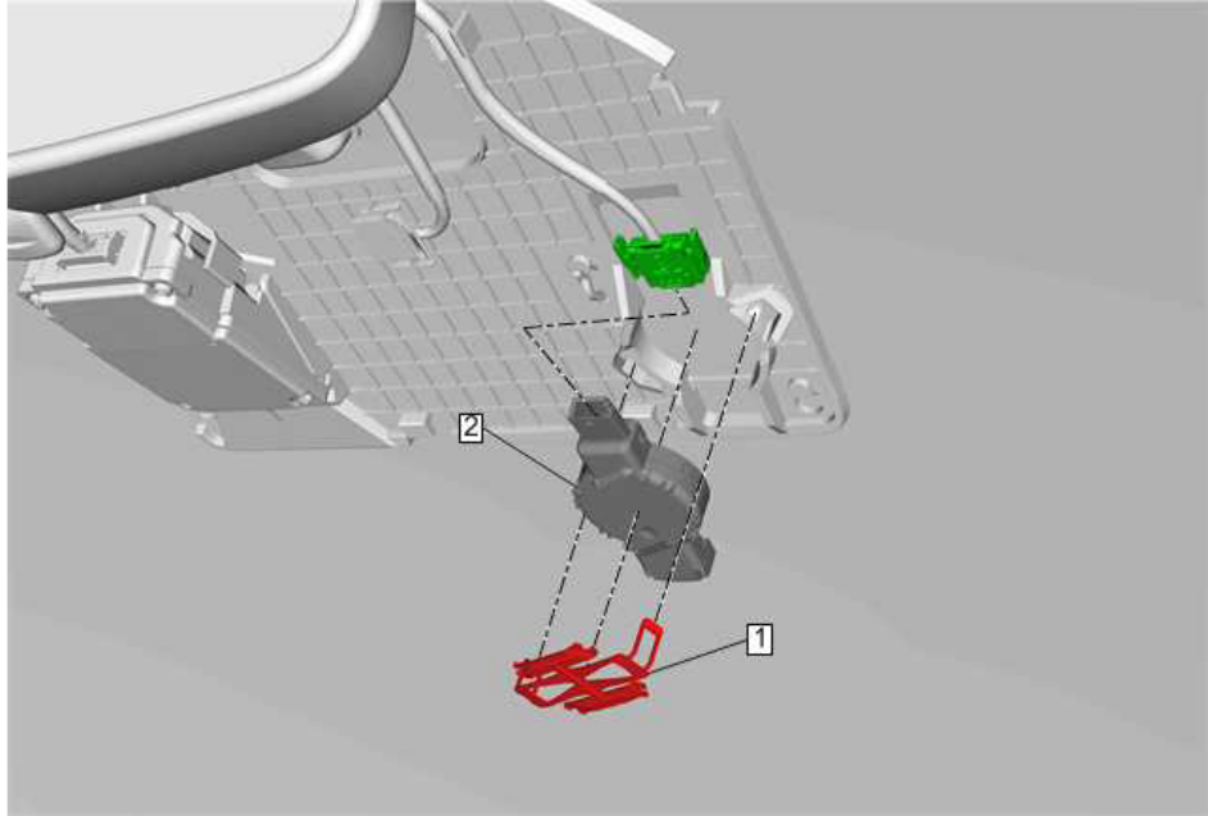


Fig. 14: Windshield Outside Moisture/Ambient Light and Humidity Sensor
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Windshield Multifunction Sensor Mount Bracket Cover Replacement (with Front View Camera)	
1	Windshield Outside Moisture/Ambient Light and Humidity Sensor Retainer Procedure Unlock the retaining tabs.
2	Windshield Outside Moisture/Ambient Light and Humidity Sensor Procedure Disconnect the electrical connector.

INSIDE AIR MOISTURE AND WINDSHIELD TEMPERATURE SENSOR REPLACEMENT (WITHOUT FRONT VIEW CAMERA)

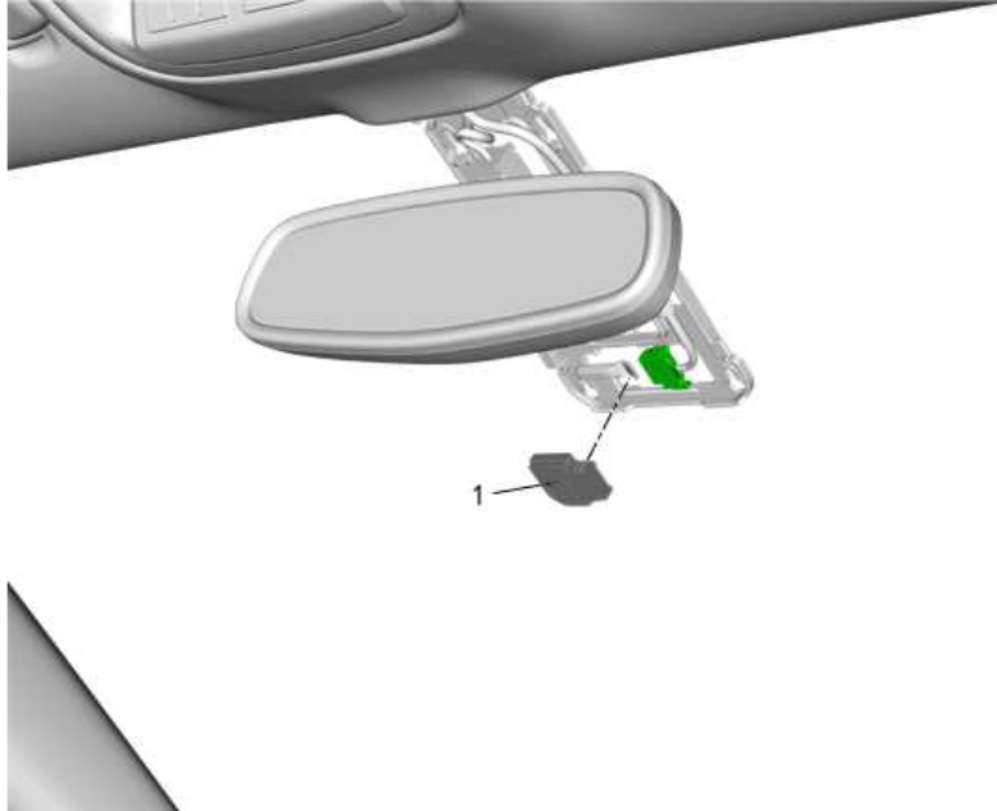


Fig. 15: Inside Air Moisture and Windshield Temperature Sensor

Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
Preliminary Procedure	
<u>Windshield Multifunction Sensor Mount Bracket Cover Replacement (without Front View Camera)</u>	
1	Inside Air Moisture and Windshield Temperature Sensor Procedure 1. Unclip the inside air moisture and windshield temperature sensor from the inside rearview mirror support bracket 2. Disconnect the electrical connector.

SUN LOAD, AMBIENT LIGHT, AND CHARGE INDICATOR SENSOR REPLACEMENT

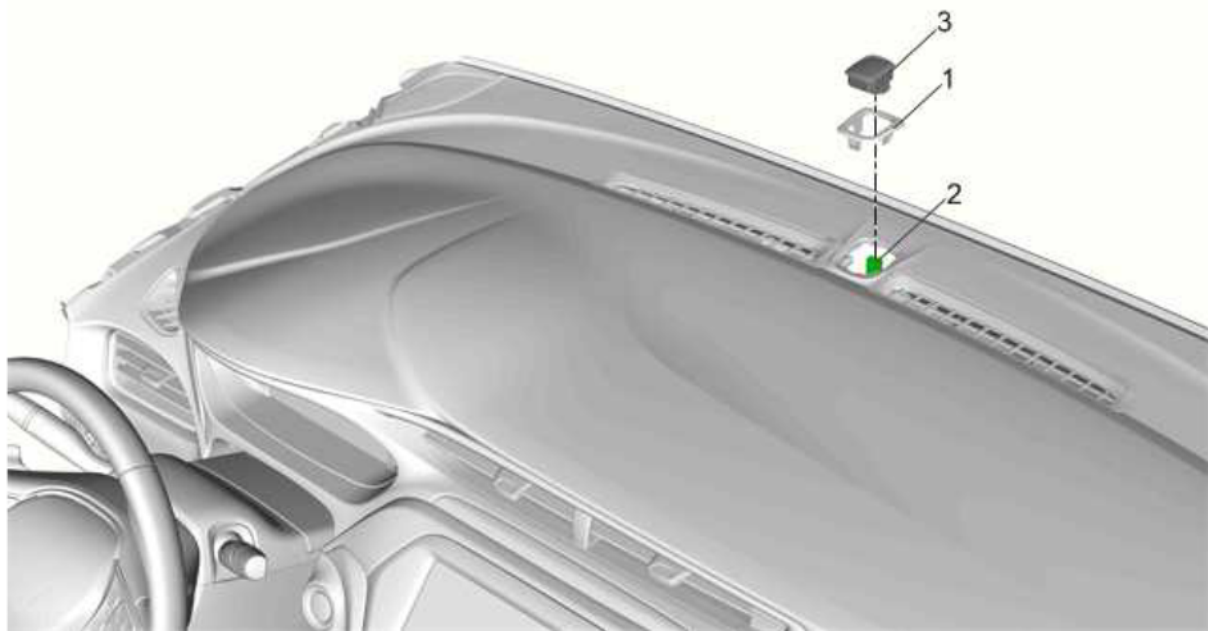


Fig. 16: Sun Load, Ambient Light, and Charge Indicator Sensor
 Courtesy of GENERAL MOTORS COMPANY

Call out	Component Name
1	Daytime Running Lamp Ambient Light Bezel Procedure Using a plastic trim tool to release the bezel from the instrument panel.
2	Sun Load, Ambient Light, and Charge Indicator Sensor Connector Procedure Disconnect the electrical connector.
3	Sun Load, Ambient Light, and Charge Indicator Sensor Procedure Separate the sensor from the bezel.

BLOWER MOTOR CONTROL MODULE REPLACEMENT

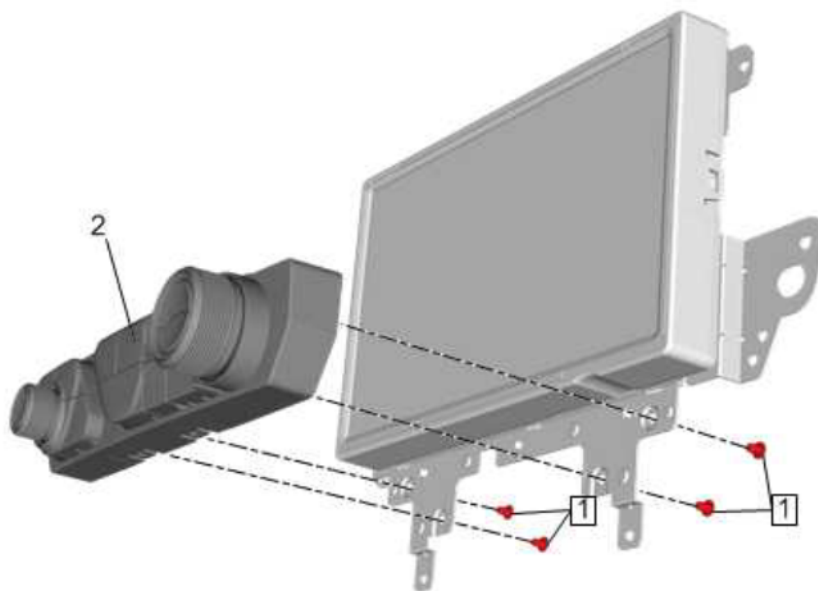


Fig. 17: Blower Motor Control Module
 Courtesy of GENERAL MOTORS COMPANY

Callout	Component Name
Preliminary Procedure Driver Information Display Replacement	
1	Blower Motor Control Module Bolt (Qty: 4) CAUTION: Refer to Fastener Caution . Tighten 2.5 N.m (22 lb in)
2	Blower Motor Control Module

DESCRIPTION AND OPERATION

AUTOMATIC HVAC DESCRIPTION AND OPERATION

The air temperature and the air delivery description and operation are divided into the following areas:

- HVAC Control Components
- Air Speed
- Air Delivery
- Heating and A/C Operation
- Recirculation Operation
- Automatic Operation
- Coolant Heater Control Module
- Coolant and A/C System Refrigerant

HVAC Control Components

HVAC Control

The HVAC control contains all the switches and knobs which are required to control the functions of HVAC and serve as interface between the operator and the HVAC control module. The HVAC controls are part of the radio/HVAC controls assembly. The selected values are passed to the HVAC control module via serial data.

HVAC Control Module

The HVAC control module is a serial data device that interfaces between the operator and the HVAC system to maintain and control desired air temperature and air distribution settings. The battery positive voltage circuit provides power that the HVAC control module uses for keep alive memory. If the battery positive voltage circuit loses power, all HVAC DTCs and settings will be erased from keep alive memory. The body control module (BCM), which is the vehicle power mode master, provides a device ON-Signal. The HVAC control module provides blower, air delivery mode and air temperature settings.

The HVAC control module supports the following features:

Feature	Availability
Afterblow	Available if reprogrammed by the technician
Purge	Yes
Personalization	Yes
Actuator Calibration	Yes

Actuators

Doors in the HVAC case assembly are used to control air flow. The HVAC control module operates the doors through the use of actuators, with one actuator being used for each door. The system has the following air control doors and associated actuators: mode, temperature, and recirculation.

Each actuator used in the system is a 5-wire stepper motor. The HVAC control module supplies a 12 V reference voltage to the stepper motor and energizes the 4 stepper motor coils with a pulsed ground signal. The stepper motor moves the associated air control door into the calculated position in order to reach the selected position. The null point of the stepper motor will be calibrated, if the stepper motor is new. When the stepper motor is calibrated, the HVAC control module can drive the applicable coil to reach exactly the desired position of the air control door.

Blower Motor Control Module

The blower motor control module controls the speed of the blower motor by increasing or decreasing the voltage drop on the ground side of the blower motor. The HVAC control module provides a low side pulse width modulation (PWM) signal to the blower motor control module via the blower motor speed control circuit. As the requested blower speed increases, the HVAC control module increases the amount of time that the speed signal is modulated to ground. As the requested blower speed decreases, the HVAC control module decreases the amount of time that the signal is modulated to ground.

Duct Temperature Sensors

The air temperature sensors are 2-wire negative temperature co-efficient thermistors. The sensors operate within a temperature range of -40 to +85°C (-40 to +185°F). The sensors are installed in the air distribution ducts and measure the temperature of the air that streams from the ducts. The HVAC control module uses these values to calculate the mixed air flap position.

A/C Refrigerant High Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2 - 4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The engine control module (ECM) converts the voltage signal to a pressure value. When pressure is too high or too low, the ECM will not allow the A/C compressor to engage.

A/C Refrigerant Low Pressure Sensor

The A/C refrigerant pressure sensor is a 3-wire piezoelectric pressure transducer. A 5 V reference voltage, low reference, and signal circuits enable the sensor to operate. The A/C pressure signal can be between 0.2 - 4.8 V. When the A/C refrigerant pressure is low, the signal value is near 0 V. When the A/C refrigerant pressure is high, the signal value is near 5 V. The Hybrid/EV Powertrain Control Module 2 monitors the low side refrigerant pressure through the A/C pressure sensor.

A/C Compressor

The AC compressor function is to provide refrigerant flow in the AC refrigerant loop to help cool down the cabin, help dehumidify the air in a defrost mode and help maintain the battery temperature. Rather than a more-typical pulley, the A/C compressor uses a 3-phase alternating current, high voltage electric motor to operate. It has an on-board inverter that takes high voltage direct current from the vehicle's high voltage battery and inverts it to alternating current for the motor. The AC compressor shall be activated when any of the three following events occur:

- The customer pushes the AC button or
- The HVAC control, in ECO climate or Comfort Climate Settings, requests the electric AC compressor on to help in cooling the cabin or removing moisture in conditions where the windows may fog or
- The hybrid/EV powertrain control module 2 requests the AC compressor on to help maintain the battery temperature

The hybrid/EV powertrain control module 2 uses values from the A/C refrigerant pressure sensor, duct temperature sensors, ambient air temperature sensor, passenger compartment temperature sensor, battery cell temperature sensors, battery coolant temperature sensors, and battery coolant pumps to determine the speed at which the compressor will operate. This message is sent from the hybrid/EV powertrain control module 2 to the A/C compressor control module via serial data message.

Ambient Light/Sunload Sensor

The ambient light/sunload sensor includes the sunload sensor and passenger compartment temperature sensor.

This sensor assembly provides information about:

- Sun heat intensity
- Passenger compartment temperature

The solar sensor is connected to ground and to a 5 V stabilized voltage supply through the HVAC control module. As the sunload increases, the sensor signal voltage also increases and vice versa. The signal varies between 1.4 - 4.5 V and is provided to the HVAC control module.

The passenger compartment temperature sensor is a negative temperature co-efficient thermistor. A signal and low reference circuit enables the sensor to operate. As the air temperature increases, the sensor resistance decreases. The sensor signal varies between 0 - 5 V.

Bright or high intensity light causes the vehicles interior temperature to increase. The HVAC system compensates for the increased temperature by diverting additional cool air into the vehicle.

Windshield Temperature and Inside Moisture Sensor

The windshield temperature and inside moisture sensor includes the relative humidity sensor, windshield temperature sensor and humidity sensing element temperature sensor.

This sensor assembly provides information about:

- Relative humidity level at windshield (compartment side)
- Temperature of the windshield inside (compartment side)
- Temperature of the humidity sensor element

The relative humidity sensor measures the relative humidity of the compartment side of the windshield. It also detects the temperature of the windshield surface on the passenger compartment side. Both values

are used as control inputs for the HVAC control module application to calculate the fog risk on windshield compartment side and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist build-up on the windshield. The humidity sensor element temperature sensor supplies the temperature of the humidity sensor element.

When equipped with RPO CE1, the HVAC control module receives this information via serial data from the rain sensor module. When not equipped with CE1, the sensor values are received from signal circuits to the HVAC control module. signal circuits

HVAC Coolant Pump

The coolant heater pump is controlled by a relay. When operating conditions exist that requires coolant flow, the HVAC control module turns ON the heater coolant pump by applying ground to the relay control circuit which energizes the heater coolant pump relay.

Air Speed

The blower control switch is part of the HVAC faceplate control. The selected value of the blower switch position is sent to the HVAC control module via serial data.

The blower motor control circuitry is integrated within the blower motor control module. The HVAC control module provides a ground pulse width modulation (PWM) signal to the blower motor control module to request a specific motor speed. The blower motor control module translates the PWM signal and drives the motor accordingly.

Air Delivery

The HVAC control module controls the distribution of air within the passenger compartment by the use of the mode actuator. The modes that may be selected are:

- Defrost
- Defog
- Panel
- Floor
- BiLevel

In auto mode, the air delivery mode is controlled automatically based on cooling/warming needs of the compartment. The desired air distribution mode can be selected with the air distribution buttons at the HVAC faceplate control. The HVAC control delivers the values to the HVAC control module via serial data. The HVAC control module controls the mode actuator so that it drives the flap to the calculated position. Depending on the position of the flap, air is distributed through various ducts leading to the outlets in the dash. Turning the mode flap to the defrost position, the HVAC control module will move the recirculation actuator to outside air, reducing window fogging. When defrost is selected, the blower motor will be activated. The HVAC control module enables a high volume of air delivered to the front defrost vents. A/C is available in all modes.

The rear window defogger does not affect the HVAC system.

Recirculation Operation

The recirculation switch is integrated into the HVAC control. The selected recirculation switch position is sent to the HVAC control module via LIN-Bus. The HVAC control module controls the air intake using the recirculation actuator. In recirculation mode the recirculation door opens in order to circulate the air within the vehicle. In fresh air mode the recirculation door is closed in order to route outside air into the vehicle.

Inside air recirculation is prevented if the defrost mode is active. When the defrost mode is active, the recirculation actuator opens the recirculation door and outside air is circulated to the windshield to reduce fogging.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on passenger compartment side of the windshield compartment side. The A/C compressor and the defrost mode are activated to prevent or remove fog on the passenger compartment side of the windshield.

Heating and A/C Operation

The purpose of the heating and A/C system is to provide heated and cooled air to the interior of the vehicle. The A/C system will also remove humidity from the interior and reduce windshield fogging. Regardless of the temperature setting, the following can affect the rate that the HVAC system can achieve the desired temperature:

- Ambient air temperature
- Difference between inside and desired temperature
- Blower motor speed setting
- Mode setting
- Air conditioning control module operation
- Hybrid/EV powertrain control module 2 operation
- Coolant heater control module

Pressing the climate mode buttons (Comfort Mode or ECO Mode) enables the HVAC control module to determine whether to request A/C compressor and coolant heater activation. Based on the thermal conditions of the vehicle the HVAC control module sends a serial data message to the hybrid/EV powertrain control module 2 for the A/C request. The hybrid/EV powertrain control module 2 will request the A/C compressor control Module to engage A/C. The HVAC control module sends the heating request to the coolant heater control module to produce heat.

Climate Mode button (Fan Only) will disable all heating and cooling of the vehicle unless overridden by dehumidification requirements.

Automatic Operation

The user can select to operate the Blower, Recirculation and Air Delivery operations in auto per auto operation mode.

To put the HVAC system in full automatic mode, the following is required:

1. The auto button must be pressed.
2. The system indicates that all 3 functions are being operated automatically by lighting the auto button LED.

When the auto button is pressed, the system responds by putting the blower, air delivery and recirculation into auto mode. If any of these functions are adjusted then the auto button indication shall go off and the function will leave auto operation and follow the user requested setting: auto, blower, air delivery and recirculation. In this setting the blower request is adjusted to quickly heat the cabin initially. After comfort is reached, the blower speed is minimized to reduce noise and temperature drifts.

Under cold ambient temperatures, the automatic HVAC system provides heat in the most efficient manner. The operator can select an extreme temperature setting but the system will not warm the vehicle any faster. Under warm ambient temperatures, the automatic HVAC system also provides air conditioning in the most efficient manner. Selecting an extreme cool temperature will not cool the vehicle any faster.

In automatic mode the values of the windshield temperature and inside moisture sensor are used as control inputs for the HVAC control module application to calculate the fog risk on the passenger compartment side of the windshield and ability to reduce fuel consumption by decreasing A/C compressor power to a minimum without causing any fog. The A/C compressor and the defrost mode may be activated to prevent or remove fog on the passenger compartment side of the windshield. The sensor will also enable partial recirculation mode in order to improve heat-up performance of the passenger compartment under cold ambient temperature conditions without the risk of mist building on the windshield.

Coolant Heater Control Module

The coolant heater control module is a high voltage electric heater. High voltage is supplied from the hybrid/EV battery pack. A fused battery input, ground, and LIN serial data from the HVAC control module are used to control the operation of the coolant heater control module.

The coolant heater control module is an essential element of the hybrid heating system. When cabin heat is required, the HVAC control module commands the coolant heater control module activation via serial data, and commands the coolant pump relay on to operate the coolant pump to circulate the coolant. Heated coolant from the coolant heater will meet HVAC temperature demands. The coolant heater control module will be commanded OFF if the coolant temperature exceeds the desired temperature.

Heater coolant enters the heater core through the inlet heater hose, in a pressurized state. The heater core is located inside the HVAC module. The ambient air drawn through the HVAC module, absorbs the heat of the coolant flowing through the heater core. Heated air is distributed to the passenger compartment, through the HVAC module, for passenger comfort. Opening or closing the air temperature flap controls the amount of heat delivered to the passenger compartment. The coolant exits the heater core through the return heater hose and recirculates back to the system.

Coolant and A/C System Refrigerant

For information on coolant, coolant flow, A/C refrigerant, and the A/C refrigerant cycle, refer to [Heating and Air Conditioning System Description and Operation](#) .
